Statistical Analysis of Produced Water and Water Based Mud Samples

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E-1. Summary

This appendix describes the methods used and the results obtained from statistically analyzing constituent analytical results obtained from a field monitoring program that includes produced water (PW) and water based muds (WBM) samples. The data set includes analytical results for 270 PW samples collected from December 11, 2013 through April 13, 2015; 8 duplicate PW samples collected for quality assurance purposes were also evaluated. Although 102 WBM samples were collected, the number of samples analyzed varied by matrix: 77 WBM—solid (WBM-S) samples collected from January 23, 2014 through March 27, 2015; and 24 WBM—aqueous samples collected from September 2, 2013 through March 18, 2015. The chemicals analyzed include arsenic, cadmium, hexavalent chromium, copper, cyanide, lead, mercury, nickel, selenium, silver, and zinc. The percentage of non-detects in these data range from 100% for the silver PW data set to 0% for the lead and zinc WBM-S data set. Methods for robustly analyzing data sets with censored data are needed.

Many methods for accommodating censored observations notably include simple substitution. Although simple substitution such as one-half the detection limit is commonly used (and even recommended in some articles and federal reports), there is no real theoretical justification for this procedure. Substitution might perform poorly compared to other more statistically robust procedures, especially where censored data represent a high proportion of the entire data set. Substitution can introduce artificial patterns that are not present in the original data. This can lead to incorrect computation of summary statistics and hypothesis testing (Helsel 2012). Using different terminology from that used herein, Helsel (2012) discourages reporting non-detects as "less-than the reporting limit", and gives preference to reporting non-detects as "less than the detection limit." As used within the OOC data set, the modified method detection limit (MDL) is the MDL adjusted for dilution and sample size used to set the MDL. This practice is used in this report and is consistent with the USEPA guidance (USEPA 2013) which gives deference to the analyst to use the correct numerical values for non-detects as the "reported detection limit or [reporting limit] values."

Where applicable, procedures from USEPA's ProUCL (v5.0.00) are used to estimate means, upper confidence limits, upper tolerance limits, and upper prediction limits for censored data sets (USEPA 2013a, b). USEPA (2013a, b) includes discussion of some of the numerical methods proposed by Helsel (2012), and concluded that the methods incorporated in ProUCL performed equal to or better than those proposed by Helsel (2012). Perhaps the most notable difference is USEPA's recommendation to employ methods that test for, and analyze data, based on a gamma distribution in preference to a lognormal distribution. USEPA's recommendation is based on extensive simulation studies and while it is beyond the scope of this attachment to independently verify these simulation studies, the results presented by USEPA (2013a) appear compelling at this time. Also, USEPA guidance (USEPA 2013a, b) and Helsel (2012) provide different recommendations regarding minimum sample size and level of censoring to use various procedures. For example, Helsel (2012, pg 93) recommends that analysis of data sets with more than 80% censoring should be limited to reporting the percentage greater than a meaningful threshold for sample sizes less than 50 and reporting high percentiles (i.e., 90^{th}, 95^{th}) for sample sizes of 50 or more. However, this requirement would generally preclude most analyses of the PW data sets. Thus, for this attachment, we have included presentation of all key results without screening for the minimum number of observations or number of detected results. Those selections are made with the interpretation of these results in the main report. Within the main report, for constituent-specific data sets with fewer than eight detected observations, the statistical analyses described in this Appendix are set aside in favor of using the maximum value detected for calculation of critical dilution factors.

E-2. Appendix Organization

The remainder of this attachment is organized into three sections: *Methods*, *Results*, and *Chemical-specific Summaries*. The *Methods* (Section E-3) focuses on the analytical framework used to analyze censored data using ProUCL such that an independent analyst could arrive at the same result. The reader is referred to USEPA (2013a, b) for an in depth discussion of any particular procedure. Some post-hoc analyses are also described. The *Results* (Section E-4) presents the outcome of the analyses using censored data and some simple spreadsheet level summaries. And finally, the *Chemical-specific Summaries* (Section E-5) includes a narrative summary for each chemical along with general statistics and a time series plot. We present the data as time-series plots simply as a way of distributing the data across the x-axis. There is no visual indication that time is an important variable. This last section could be used as a quick resource if a more in-depth review of a single analyte was needed.

E-3. Methods

E-3.1 Analyses Using ProUCL

ProUCL provides multiple tools that are applicable for censored data. The analytical framework used the following steps for each matrix/analyte:

- Organize data for input to ProUCL.
- Compute summary statistics regarding the number and extent of non-detects.
- Compute the Kaplan Meier mean and related statistics.
- Perform goodness of fit (GOF) tests to evaluate the data distribution.
- Compute the 95% upper confidence limit (UCL95) of the population mean based on GOF results.
- Compute the upper prediction limit (UPL), upper tolerance limit (UTL), and upper simultaneous limit (USL).

No direct evaluation for erroneous or outlier data was made as part of this analysis beyond those normally involved with data validation of laboratory reported data.

E-3.1.1 Organize Data

Results, data value qualifiers, and modified MDLs are extracted from the electronic data deliverables (EDDs) and compiled into data sets for each matrix (i.e., produced water [PW], water based muds—solids [WBM-S], and water based muds—aqueous [WBM-A]). Results and modified MDLs are combined into a single column by replacing the result with the modified MDL for all non-detected ("U" or "UJ" in data value qualifier field) results. An indicator variable was created based on the data value qualifiers, "0" for non-detects and "1" otherwise.

Note; however, that simple substitution is not used for the herein calculations. Rather, the above data coding is for purposes of ProUCL to indicate which results are censored at the modified MDL. The censored values can be thought of as a 'value somewhere between 0 and the modified MDL.' Results between the modified MDL and RL ("J" in data value qualifier field) were retained 'as is' for the analysis.

E-3.1.2 Compute Summary Statistics

Summary statistics including the number of observations, detected observations, non-detected observations; minimum and maximum detected concentrations; minimum and maximum non-detected concentrations (i.e., modified MDL); and the mean, median, and variance of the detected concentrations are computed using ProUCL's **Stats/Sample Sizes** command (**Stats/Sample Sizes** > **General Statistics** > **With NDs** [or **Full (w/o NDs)**] > **Raw Statistics**). It is noted that theses analyses can be made with existing spreadsheet functionality. Note that the number of observations includes results where the data qualifier is blank, "J", "UJ", and "U". Rejected results are not included in the number of observations.

E-3.1.3 Kaplan Meier Mean

The Kaplan Meier method is also known as the product limit estimation method and is based on the empirical distribution of the data with adjustments for censoring. The Kaplan Meier method has been historically used in survival analysis and is recommended by USEPA (2013a, b) and Helsel (2012) for environmental applications. The Kaplan Meier mean, variance, standard deviation, and coefficient of variation is estimated within ProUCL using the same command as described for computing summary statistics.

E-3.1.4 Goodness of Fit Tests

Before computing UCLs, UPLs, UTLs, or USLs, USEPA (2013b, pg 154-155) states that the analyst must select an appropriate choice for the data distribution. ProUCL provides multiple tools to evaluate whether the data follow a normal, gamma, or lognormal distribution. To test for normality or lognormality, the Shapiro-Wilk and Lilliefors tests are applied. The Anderson-Darling and Kolmogorov-Smirnov tests are used to test for the gamma distribution. In some instances, a data set might pass multiple tests (e.g., the data could be distributed as both gamma and lognormal). In these cases, USEPA guidance (2013b, pg 154-155) and the decision framework built into ProUCL recommends that the analyst preferentially choose normal > gamma > lognormal. If the data set does not pass a test for one of these distributions based on an analysis of the detects only, EPA guidance classifies the data as a distribution-free nonparametric data sets and that nonparametric procedures would be an option for such data sets. Goodness of fit tests can be computed using the **Statistical Tests** command (**Statistical Tests** > **Goodness-of-Fit Tests** > **With NDs** [or **Full (w/o NDs)**] > **G.O.F Statistics**). Within this report, data are classified as normal, gamma, or lognormal at the 95% confidence level. If a data set was not classified as one of the three distributions, the data set was classified as distribution free.

E-3.1.4 Upper Confidence Limit

As used herein, the upper confidence limit is the upper boundary (or limit) of a confidence interval of the population mean. USEPA (2013b) recommends that the Kaplan Meier method is the preferred method since it handles multiple detection limits. Further EPA states (USEPA 2013b, pg 210) "*depending upon the data set size, distribution of the detected data, and data skewness, the various nonparametric and hybrid KM UCL95 methods including KM (BCA), bootstrap-t KM UCL, Chebyshev KM UCL, Gamma-KM UCL based upon the KM estimates provide good coverages for the population mean.*" The 95% UCL of the mean was computed using the **UCLs/EPCs** command (**UCLs/EPCs** > **With NDs** [or **Full (w/o NDs)**] > **Normal** [or **Gamma** or **Lognormal** or **Non-parametric**]). Where bootstrapping was employed, 10,000 iterations are used.

In some cases, ProUCL will suggest more than one estimate of the UCL. EPA guidance (USEPA 2013 a, b) indicates that it is appropriate to use either estimate and does not give a preference for one method over another. Results from one method, however; the gamma ROS (GROS) are not included in the *Results* section since it is not recommended for data sets with more than 50% non-detects which is common occurrence for the OOC data.

E-3.1.5 Upper Prediction, Tolerance, and Simultaneous Limits

USEPA (2013a) defines the upper prediction limit (UPL), upper tolerance limit (UTL), and upper simultaneous limit (USL) as follows:

> ***Upper Prediction Limit (UPL):*** *The upper boundary of a prediction interval for an independently obtained observation (or an independent future observation).*
>
> ***Upper Tolerance Limit (UTL):*** *A confidence limit on a percentile of the population rather than a confidence limit on the mean. For example, a 95% one-sided UTL for 95% coverage represents the value below which 95% of the population values are expected to fall with 95% confidence. In other words, a 95% UTL with coverage coefficient 95% represents a 95% UCL for the 95th percentile.*
>
> ***Upper Simultaneous Limit (USL):*** *The upper boundary of the largest value.*

Like the upper confidence limit on the mean, computing UPLs, UTLs, and USLs are also dependent on data distribution and other factors. Because these values represent higher order statistics, more attention should be considered to ensure that the larger results are representative of the population under study (USEPA, 2013a, pg 147). The 90%, 95%, and 99% UPLs, UTLs and USLs are computed using the **Upper Limits/BTVs** command (**Upper Limits/BTVs** > **With NDs** [or **Full (w/o NDs)**] > **Normal** [or **Gamma** or **Lognormal** or **Non-parametric**]). Where bootstrapping was employed, 10,000 iterations are used. The coverage coefficient was set to 95% in all evaluations.

ProUCL provides two estimates of upper thresholds for gamma distributed data. According to USEPA (2013a, pg 94) "*for mildly skewed to moderately skewed gamma distributed data sets, [the] Hawkins-Wixley and [...] Wilson-Hilferty approximations yield fairly comparable UTLs. However for highly skewed data sets [...] with higher variability, the [Hawkins-Wixley] method tends to yield higher limits than the [Wilson-Hilferty] method.*" For presentation purposes, the results from the Wilson-Hilferty method for gamma distributed data are integrated with results from data sets with other distributions while the results from the Hawkins-Wixley method are compiled separately.

E-3.2 Sample Size Discussion

As stated earlier, Helsel (2012, pg 93) recommends that analysis of data sets with more than 80% censoring should be limited to reporting the percentage greater than a meaningful threshold for sample sizes less than 50 and reporting high percentiles (i.e., 90^{th}, 95^{th}) for sample sizes of 50 or more. However, this requirement would generally preclude most analyses of the PW data sets.

Sections 1.12 and 2.11 of USEPA (2013b, p28, p 47) provide warning to analysts interested in computing exposure point concentrations (EPCs). While the EPA guidance (see below for selected quotes) has been probably written with a different audience in mind, these cautions are generally applicable here and perhaps even ambitious when contrasted with the Helsel (2012) recommendations. For this appendix, we have included all key results without screening for the minimum number of observations or number of

detected results. Within the main report, for constituent-specific data sets with fewer than eight detected observations, the statistical analyses described in this Appendix are set aside in favor of using the maximum value detected for calculation of critical dilution factors.

> *When all of the sampled values are reported as NDs, the EPC term and other statistical limits should also be reported as a ND value, perhaps by the maximum reporting limit (RL) or the maximum RL/2. Statistics (e.g., UCL95) computed based upon only a few detected values (e.g., < 4) cannot be considered reliable enough to estimate the EPC terms having potential impact on human health and the environment. When the number of detected values is small, it is preferable to use ad hoc methods rather than using statistical methods to compute the EPC terms and other upper limits. Specifically, it is suggested that for data sets consisting of less than 4 detects and for small data sets (e.g., size < 10) with low detection frequency (e.g., < 10%), the project team and the decision makers together should decide on a site specific basis on how to estimate the average exposure (EPC term) for the constituent and area under consideration. For such data sets with low detection frequencies, other measures such as the median or mode represents better estimates (with lesser uncertainty) of the population measure of central tendency.*
>
> *Additionally, it is also suggested that when most (e.g., > 95%) of the observations for a constituent lie below the DLs, the sample median or the sample mode (rather than the sample average) may be used as an estimate the EPC term. Note that when the majority of the data are NDs, the median and the mode may also be represented by a ND value. The uncertainty associated with such estimates will be high. The statistical properties, such as the bias, accuracy, and precision of such estimates, would remain unknown. In order to be able to compute defensible estimates, it is always desirable to collect more samples.*
>
> - *ProUCL 5.0 provides warning messages and recommendations for datasets with insufficient amount of data to calculate meaningful estimates and statistics of interest. For example, it is not desirable to compute an estimate of the EPC term based upon a discrete data set of size less than 5, especially when NDs are also present in the data set.*
> - *However, to accommodate the computation of UCLs and other limits based upon ISM data sets, ProUCL 5.0 allows users to compute UCLs, UPLs, and UTLs based upon data sets of sizes as small as 3.*
> - *It is suggested that for discrete data sets, the users should use at least 10 observations to compute UCLs and various other limits.*
> - *Some examples of datasets with insufficient amount of data include datasets with less than 3 distinct observations, datasets with only one detected observation, and datasets consisting of all nondetects.*

E-3.3 Post-hoc Analyses

E-3.3.1 Water Based Muds—Solids Comparison

The WBM-S data are compared to metal concentrations in generic drilling fluids (see USEPA 1993, Table VII-7). The minimum and maximum concentrations were selected from Table VII-7 and are presented as the first two columns with concentration data in Table E-1. These data are reported in mg/kg on a dry

weight basis while the OOC data are reported on a wet weight basis. For comparison purposes, it was assumed that WBM ranged in moisture content from 68% to 91% or a solids content of 32 to 9% (OOC. 2015, personal communication). These estimated solids concentrations are applied to the metal concentrations in generic drilling fluids data to compute ranges on a wet weight basis. The result of these calculations are shown in the next four columns of Table E-1. From these four columns, the overall minimum and maximum concentrations are selected for comparing to the WBM-S data that are reported on a wet weight basis.

E-3.3.2 Comparison to Water Quality Criteria and Calculation of Critical Dilutions

The 95% upper confidence limit of the mean (UCL95) and the upper 95th percentile confidence limit on the 95th percentile (95UTL95) for PW and WBM-A are compared to USEPA water quality criteria for the purposes of estimating critical dilutions.

E-3.3.3 Comparison of Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples

The Kendall's tau correlation coefficient is computed for matched WBM-S and WBM-A samples, after removing records with a rejected ("R") data qualifier, using the cenken procedure available in the R package NADA (Lee 2013). The cenken procedure also computes the Akritas-Theil-Sen nonparametric line with Turnbull estimate of intercept. This procedure is selected over other potential procedures because it allows for censoring in both the x and y variable. As described by Lee (2013) the slope is computed using an iterative bisection method to search for a slope that would result in a Kendall's tau value of 0 for correlation. The intercept is the median residual.

E-4. Results

Data are obtained from a field monitoring program that includes PW and WBM samples. The data set includes analytical results for 274 PW samples collected from December 11, 2013 through April 13, 2015; 77 WBM-S samples collected from January 23, 2014 through March 27, 2015; and 24 WBM-A samples collected from September 2, 2013 through March 18, 2015. The chemicals analyzed include: arsenic, cadmium, hexavalent chromium, copper, cyanide, lead, mercury, nickel, selenium, silver, and zinc. The percentage of non-detects in these data range from 100% for the silver PW data set to 0% for the lead and zinc WBM-S data set.

See the Methods section for the procedures used to analyze the data. Interpretation of significant findings are presented in the main report.

E-4.1 Analyses Using ProUCL

E-4.1.1 Summary Statistics

Table E-2, Table E-3, and Table E-4 present summary statistics for the PW, WBM-S, and WBM-A, respectively. The number of observations of PW by chemical ranges from 244 for dissolved hexavalent chromium to 277 for five chemicals. The number of detected observations ranges from 0 for silver to 124 for zinc. The number of detected observations for the other chemicals range from 1 to 37. The percentage of non-detects is 55% for zinc and more than 86% for the other chemicals. The number of observations of WBM-S by chemical ranges from 72 for hexavalent chromium to 77 for nine chemicals. The number of detected observations ranges from 7 for cyanide to 77 for lead and zinc. The percentage of non-detects ranges from a low of 0% for lead and zinc to 91% for cyanide. The number of observations of WBM-A by

chemical ranges from 21 for dissolved cyanide to 24 for seven chemicals. The number of detected observations ranges from 2 for silver to 21 for arsenic. The percentage of non-detects ranges from a low of 12.5% for arsenic to 91.7% for silver. Table E-2, Table E-3, and Table E-4 also includes the minimum and maximum non-detected concentration (i.e., modified MDL) and the mean, median, and variance of the detected concentrations.

E-4.1.2 Kaplan Meier Mean

Table E-5 presents the mean, variance, standard deviation, and coefficient of variation calculated using the Kaplan Meier method. Estimates for silver PW are not possible since all results are non-detects. The Kaplan Meier mean concentration for PW ranged from 5.33×10^{-5} mg/L for mercury to 2.092 mg/L for zinc. The Kaplan Meier mean concentration for WBM-S ranged from 0.127 mg/kg for cyanide to 101.2 mg/kg for lead. The Kaplan Meier mean concentration for WBM-A ranged from 0.00303 mg/L for mercury to 3.499 mg/L for zinc.

E-4.1.3 Goodness of Fit Test

Table E-6, Table E-7, and Table E-8 present the goodness of fit test results for PW, WBM-S, and WBM-A, respectively. Based on the procedures described in the Methods section, four chemicals are classified as gamma distributed, 2 chemicals as normally distributed, and three chemicals as distribution free for produced waters. Silver and dissolved hexavalent chromium could not be evaluated. For WBM-S, seven chemicals are classified as gamma, three chemicals as normal, and one chemical as lognormal. For WBM-A, five chemicals are classified as gamma, four chemicals as normal, and one chemical as lognormal. Silver could not be evaluated.

E-4.1.4 95% Upper Confidence Limit of the Mean

Table E-6, Table E-7, and Table E-8 also present the 95% upper confidence limit of the mean. In some cases, ProUCL will suggest more than one estimate of the UCL. These three tables have been organized into two sets of columns to show the multiple results referred to as 'selected' and 'alternative' methods. In general, deference was given to 'selecting' the gamma Kaplan Meier method results over the other methods and giving a lower priority to bootstrap-based methods. The presentation in these tables was largely chosen for convenience in later post-hoc analyses and an alternative decision is equally valid since EPA guidance (USEPA 2013 a, b) indicates that it is appropriate to use either estimate and does not give a preference for one method over another.

The 95% upper confidence limit of the mean for PW ranged from 5.94×10^{-5} mg/L for mercury to 4.569 mg/L for zinc. The 95% upper confidence limit of the mean for WBM-S ranged from 0.187 mg/kg for mercury to 126.2 mg/kg for lead. The 95% upper confidence limit of the mean for WBM-A ranged from 0.007 mg/L for mercury and hexavalent chromium to 14.98 mg/L for zinc.

E-4.1.5 Upper Prediction, Tolerance, and Simultaneous Limits

Table E-9, Table E-10, and Table E-11 present the upper prediction limit (UPL), upper tolerance limit (UTL), and upper simultaneous limit (USL) for PW, WBM-S, and WBM-A, respectively. Table E-12, Table E-13, and Table E-14 present the alternative Hawkins-Wixley results for gamma distributed data. Like the UCL discussion above, the Hawkins-Wixley results in Table E-12, Table E-13, and Table E-14 could be substituted for the results in Table E-9, Table E-10, and Table E-11.

E-4.2 Post-Hoc Analyses

E-4.2.1 Water Based Muds—Solids Comparison

Table E-15 presents a comparison of WBM-S observations to metal concentrations in generic drilling fluids. More than one-half of the detected observations for arsenic, cadmium, lead, nickel, and zinc are greater than the maximum generic drilling fluids concentrations. Less than one-half of the detected observations for hexavalent chromium, copper, mercury, selenium, and silver are greater than the maximum generic drilling fluids concentrations. No evaluation of cyanide was possible due to lack of data provided in USEPA (1993).

E-4.2.2 Comparison to Water Quality Criteria and Calculation of Critical Dilutions

Table E-16 presents the marine chronic and acute water quality criteria and 95% upper confidence limit of the mean (UCL95) for PW and WBM-A. Table E-16 also presents the critical dilution calculation (i.e., threshold/UCL95). Table E-17 presents the marine chronic and acute water quality criteria and 95% upper confidence limit of the 95th percentile (95UTL95) for PW and WBM-A. Table E-17 also presents the critical dilution calculation (i.e., threshold/95UTL95). Where appropriate, interpretation of these results is provided in the main report.

E-4.2.3 Comparison of Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples

Data for 13 matched WBM-S and WBM-A samples are available for analysis. The p-value associated with the Kendall's tau correlation coefficients for arsenic, lead, mercury, nickel, and zinc are less than 0.10. The p-value associated with the Kendall's tau correlation coefficients for cadmium, hexavalent chromium, copper and selenium are greater than 0.10. The Kendall's tau correlation coefficient could not be calculated for cyanide and silver due to lack of detected aqueous results. These results, together with the Akritas-Theil-Sen nonparametric line with Turnbull estimate of intercept (for analytes where the p-value is less than 0.10) are presented in Table E-18. It is noteworthy that some intercepts and the slope for one chemical are negative, likely limiting their potential utility. Scatterplots of these data and the fitted lines (where applicable) are presented in Figures E-1 to E-11.

Table E-1. Estimation of Metal Concentrations in Generic Drilling Fluids on Wet Weight Basis Based on Dry Weight Data from USEPA 1993

Analyte	Metal Concentrations in Generic Drilling Fluids (USEPA 1993) (mg/kg Dry Weight Basis)		Metal Concentrations in Generic Drilling Fluids (mg/kg Wet Weight Basis assuming 32% solids)		Metal Concentrations in Generic Drilling Fluids (mg/kg Wet Weight Basis assuming 9% solids)		Metal Concentrations in Generic Drilling Fluids Used for comparison to WBM-S data (mg/kg Wet Weight Basis)	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Arsenic	0.258	17.200	0.0826	5.50	0.0232	1.55	0.0232	5.50
Cadmium	0.042	0.717	0.013	0.229	0.0038	0.0645	0.0038	0.229
Chromium	<3.0	908	<0.96	291	<0.27	81.7	<0.27	291
Copper	0.70	77.30	0.22	24.7	0.063	6.96	0.063	24.7
Cyanide	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed	Not Listed
Lead	1.17	52.5	0.374	16.8	0.105	4.73	0.105	16.8
Mercury	<0.010	0.7530	<0.0032	0.241	<0.00090	0.0678	<0.00090	0.241
Nickel	<6.0	9.80	<1.9	3.1	<0.54	0.88	<0.54	3.1
Selenium	<3.0	<3.0	<0.96	<0.96	<0.27	<0.27	<0.27	<0.96
Silver	<0.060	1.390	<0.019	0.445	<0.0054	0.125	<0.0054	0.445
Zinc	2.26	90.40	0.723	28.9	0.203	8.14	0.203	28.9

Table E-2. Produced Water (mg/L, all depths)—Summary Statistics

	Total Obs.		Detect (D) Statistics							Non-detect (ND) Statistics				
PW (mg/L, all depths)	Total Number of Obs. (#)	Number of Distinct Obs. (#)	Number of Detected Obs. (#)	Number of Distinct Detects (#)	Minimum Detect (mg/L)	Maximum Detect (mg/L)	Variance Detects $(mg/L)^2$	Mean Detects (mg/L)	Median Detects (mg/L)	Number of ND Obs. (#)	Number of Distinct Non-Detects (#)	Percent Non-Detects (%)	Minimum Non-Detect (mg/L)	Maximum Non-Detect (mg/L)
Arsenic	273	41	32	32	0.00224	0.594	0.0182	0.106	0.0695	241	9	88.28%	0.001	5
Cadmium	277	12	3	3	0.0197	0.102	0.00204	0.0501	0.0285	274	9	98.92%	0.0008	2.5
Chromium, Hexavalent, Dissolved	244	6	1	1	0.0219	0.0219	-	-	-	243	5	99.59%	0.00002	0.001
Copper	274	21	12	12	0.00178	0.332	0.0176	0.102	0.0196	262	9	95.62%	0.001	5
Cyanide, Dissolved	269	5	4	4	0.022	0.0415	0.00010086	0.0324	0.033	265	1	98.51%	0.02	0.02
Lead	277	23	14	14	0.00175	3.27	0.821	0.51	0.133	263	9	94.95%	0.0007	2.5
Mercury	272	32	37	31	0.000043	0.000597	2.1224E-08	0.000125	0.000079	235	1	86.40%	0.000042	0.000042
Nickel	271	33	26	26	0.00194	0.374	0.0111	0.0997	0.0646	245	7	90.41%	0.005	4.5
Selenium	277	30	21	21	0.00177	0.257	0.00469	0.0524	0.0222	256	9	92.42%	0.001	9
Silver	277	9	0	0	-	-	-	-	-	277	9	100.00%	0.0008	4
Zinc	277	126	124	118	0.0106	104	188.2	4.627	0.398	153	8	55.23%	0.0125	12.5

Table E-3. Water Based Muds—Solids (mg/kg, all depths)—Summary Statistics

	Total Obs.		Detect (D) Statistics							Non-detect (ND) Statistics				
WBM-S (mg/kg, all depths)	Total Number of Obs. (#)	Number of Distinct Obs. (#)	Number of Detected Obs. (#)	Number of Distinct Detects (#)	Minimum Detect (mg/kg)	Maximum Detect (mg/kg)	Variance Detects $(mg/kg)^2$	Mean Detects (mg/kg)	Median Detects (mg/kg)	Number of ND Obs. (#)	Number of Distinct Non-Detects (#)	Percent Non-Detects (%)	Minimum Non-Detect (mg/kg)	Maximum Non-Detect (mg/kg)
Arsenic	77	73	76	72	0.295	225	839	18.22	10.3	1	1	1.30%	0.0954	0.0954
Cadmium	77	72	60	59	0.0566	1.13	0.0621	0.342	0.291	17	15	22.08%	0.0452	0.553
Chromium, Hexavalent	72	53	19	18	0.714	11.4	5.867	2.287	1.48	53	35	73.61%	0.67	1.76
Copper	77	75	76	74	0.557	97.1	484.3	28.29	23.5	1	1	1.30%	0.0954	0.0954
Cyanide	76	43	7	7	0.574	1.14	0.0549	0.809	0.824	69	39	90.79%	0.0222	0.622
Lead	77	75	77	75	2.28	490	10140.49	101.2	67.8	0	0	0.00%	-	-
Mercury	77	75	76	74	0.000895	0.624	0.0189	0.16	0.13	1	1	1.30%	0.000473	0.000473
Nickel	77	73	74	70	0.202	12.5	5.717	4.952	4.9	3	3	3.90%	0.0859	0.996
Selenium	77	64	43	39	0.198	1.74	0.0871	0.532	0.503	34	25	44.16%	0.158	1.99
Silver	77	70	42	40	0.0967	3	0.201	0.337	0.24	35	30	45.45%	0.0717	0.885
Zinc	77	76	77	76	1.56	218	2304.9601	59.48	47.5	0	0	0.00%	-	-

Table E-4. Water Based Muds—Aqueous (mg/L, all depths)—Summary Statistics

	Total Obs.		Detect (D) Statistics							Non-detect (ND) Statistics				
WBM-A (mg/L, all depths)	Total Number of Obs. (#)	Number of Distinct Obs. (#)	Number of Detected Obs. (#)	Number of Distinct Detects (#)	Minimum Detect (mg/L)	Maximum Detect (mg/L)	Variance Detects (mg/L)²	Mean Detects (mg/L)	Median Detects (mg/L)	Number of ND Obs. (#)	Number of Distinct Non-Detects (#)	Percent Non-Detects (%)	Minimum Non-Detect (mg/L)	Maximum Non-Detect (mg/L)
Arsenic	24	24	21	21	0.0032	0.828	0.0568	0.167	0.0629	3	3	12.50%	0.001	0.2
Cadmium	24	14	8	8	0.000929	0.282	0.0133	0.0952	0.0472	16	6	66.67%	0.0008	0.16
Chromium, Hexavalent	24	10	8	7	0.004	0.019	0.000025071	0.00825	0.007	16	5	66.67%	0.004	0.2
Copper	23	18	15	14	0.00309	2.5	0.644	0.559	0.218	8	4	34.78%	0.001	0.05
Cyanide, Dissolved	21	6	3	3	0.0552	0.499	0.0652	0.204	0.058	18	3	85.71%	0.02	1
Lead	24	18	14	14	0.0474	33.4	101.1	5.442	0.793	10	4	41.67%	0.0007	0.035
Mercury	23	16	15	15	0.000072	0.0255	0.000044619	0.00462	0.00201	8	1	34.78%	0.000042	0.000042
Nickel	24	19	13	13	0.007	0.461	0.0174	0.0927	0.0315	11	6	45.83%	0.005	0.2
Selenium	24	17	9	9	0.00717	0.0596	0.00032539	0.0284	0.0333	15	8	62.50%	0.001	0.2
Silver	24	9	2	2	0.0393	0.133	0.00439	0.0862	0.0862	22	7	91.67%	0.0008	0.16
Zinc	23	18	14	14	0.00599	40.3	162	5.743	0.342	9	5	39.13%	0.0025	0.125

Table E-5. Mean, Variance, Standard Deviation, and Coefficient of Variation Computed Using Kaplan Meier Method

	Mean	Variance	Standard Deviation	Coefficient of Variation
PW (mg/L, all depths)				
Arsenic	0.0161	0.00316	0.0562	3.483
Cadmium	0.00187	5.27E-05	0.00726	3.883
Chromium, Hexavalent, Dissolved	0.00010967	1.95E-06	0.0014	12.75
Copper	0.00747	0.00113	0.0337	4.507
Cyanide, Dissolved	0.0202	3.36E-06	0.00183	0.0908
Lead	0.0273	0.051	0.226	8.257
Mercury	5.33E-05	3.62E-09	6.02E-05	1.129
Nickel	0.0131	0.00185	0.043	3.282
Selenium	0.00782	0.0005304	0.023	2.945
Silver	N/A	N/A	N/A	N/A
Zinc	2.092	88.78	9.422	4.505
WBM-S (mg/kg, all depths)				
Arsenic	17.99	821.4	28.66	1.594
Cadmium	0.293	0.0598	0.245	0.835
Chromium, Hexavalent	1.101	1.973	1.405	1.276
Copper	27.92	481.9	21.95	0.786
Cyanide	0.127	0.0684	0.262	2.058
Lead[a]	101.2	10144	100.7	0.995
Mercury	0.158	0.0187	0.137	0.867
Nickel	4.767	6.269	2.504	0.525
Selenium	0.395	0.0855	0.292	0.741
Silver	0.231	0.125	0.353	1.532
Zinc[a]	59.48	2305	48.01	0.807
WBM-A (mg/L, all depths)				
Arsenic	0.149	0.0498	0.223	1.498
Cadmium	0.0333	0.00582	0.0763	2.292
Chromium, Hexavalent	0.00563	1.26E-05	0.00355	0.631
Copper	0.366	0.462	0.68	1.86
Cyanide, Dissolved	0.0483	0.0108	0.104	2.155
Lead	3.175	61.98	7.873	2.48
Mercury	0.00303	3.19E-05	0.00565	1.865
Nickel	0.0547	0.0105	0.102	1.868
Selenium	0.0145	3.08E-04	0.0176	1.211
Silver	0.00859	7.78E-04	0.0279	3.245
Zinc	3.499	99.41	9.971	2.85

N/A – not analyzed, no detected observations.

[a] Estimated using traditional methods since there are no non-detects.

Table E-6. Produced Water (mg/L, all depths)—Goodness of Fit and 95% Upper Confidence Limit of the Mean

PW (mg/L, all depths)	ProUCL Distribution Recommendation based on Goodness of Fit Test Results	Selected Method for Estimating 95% Upper Confidence Level on the Mean	Selected Value (mg/L)	Alternative Method Also Suggested by ProUCL for Estimating 95% Upper Confidence Level on the Mean	Alternative Value (mg/L)
Arsenic	Distribution Free	95% KM (Chebyshev) UCL	0.0315		
Cadmium	Normal	95% KM (t) UCL	0.00311		
Chromium, Hexavalent, Dissolved	n/a	n/a	n/a		
Copper	Gamma	95% Approximate Gamma KM-UCL	0.0125	95% KM (t) UCL	0.0112
Cyanide, Dissolved	Normal	95% KM (t) UCL	0.0204		
Lead	Gamma	95% Approximate Gamma KM-UCL	0.0791	95% KM (t) UCL	0.0506
Mercury	Distribution Free	95% KM (t) UCL	0.000059398	95% KM (% Bootstrap) UCL	0.000059853
Nickel	Gamma	95% Approximate Gamma KM-UCL	0.0188	95% KM (t) UCL	0.0177
Selenium	Gamma	95% Approximate Gamma KM-UCL	0.0107	95% KM (t) UCL	0.0105
Silver	n/a	n/a	n/a		
Zinc	Distribution Free	95% KM Chebyshev UCL	4.569		

Table E-7. Water Based Muds—Solids (mg/kg, all depths)—Goodness of Fit and 95% Upper Confidence Limit of the Mean

WBM-S (mg/kg, all depths)	ProUCL Distribution Recommendation based on Goodness of Fit Test Results	Selected Method for Estimating 95% Upper Confidence Level on the Mean	Selected Value (mg/kg)	Alternative Method Also Suggested by ProUCL for Estimating 95% Upper Confidence Level on the Mean	Alternative Value (mg/kg)
Arsenic	Gamma	95% Approximate Gamma KM-UCL	24.94	95% KM (Chebyshev) UCL	32.32
Cadmium	Gamma	95% Approximate Gamma KM-UCL	0.345	95% KM (BCA) UCL	0.337
Chromium, Hexavalent	Gamma	95% Approximate Gamma KM-UCL	1.437	95% KM (t) UCL	1.384
Copper	Gamma	95% Approximate Gamma KM-UCL	32.57	95% KM (Chebyshev) UCL	38.9
Cyanide	Normal	95% KM (t) UCL	0.196	95% KM (Percentile Bootstrap) UCL	0.538
Lead	Gamma	95% Approximate Gamma UCL	126.2		
Mercury	Gamma	95% Approximate Gamma KM-UCL	0.187	95% KM (Chebyshev) UCL	0.226
Nickel	Normal	95% KM (t) UCL	5.245	95% KM (Percentile Bootstrap) UCL	5.246
Selenium	Normal	95% KM (t) UCL	0.454	95% KM (Percentile Bootstrap) UCL	0.455
Silver	Lognormal	95% KM (t) UCL	0.299	95% KM (% Bootstrap) UCL	0.305
Zinc	Gamma	95% Approximate Gamma UCL	69.62		

Table E-8. Water Based Muds—Aqueous (mg/L, all depths)—Goodness of Fit and 95% Upper Confidence Limit of the Mean

WBM-A (mg/L, all depths)	ProUCL Distribution Recommendation based on Goodness of Fit Test Results	Selected Method for Estimating 95% Upper Confidence Level on the Mean	Selected Value (mg/L)	Alternative Method Also Suggested by ProUCL for Estimating 95% Upper Confidence Level on the Mean	Alternative Value (mg/L)
Arsenic	Gamma	95% Adjusted Gamma KM-UCL	0.28	95% KM (Chebyshev) UCL	0.352
Cadmium	Normal	95% KM (t) UCL	0.0619	95% KM (Percentile Bootstrap) UCL	0.0619
Chromium, Hexavalent	Normal	95% KM (t) UCL	0.00705	95% KM (Percentile Bootstrap) UCL	0.00703
Copper	Gamma	95% Adjusted Gamma KM-UCL	0.847	95% KM (BCA) UCL	0.619
Cyanide, Dissolved	Normal	95% KM (t) UCL	0.0975		
Lead	Gamma	95% Adjusted Gamma KM-UCL	10.26	95% KM (BCA) UCL	5.936
Mercury	Gamma	95% Adjusted Gamma KM-UCL	0.00704	95% KM (BCA) UCL	0.00541
Nickel	Lognormal	95% KM Chebyshev UCL	0.15		
Selenium	Normal	95% KM (t) UCL	0.0219	95% KM (Percentile Bootstrap) UCL	0.0213
Silver	n/a	95% KM (t) UCL	0.0228		
Zinc	Gamma	95% Adjusted Gamma KM-UCL	14.98	95% KM (BCA) UCL	7.64

Table E-9. Produced Water (mg/L, all depths)—UTLs, UPLs, and USLs

PW (mg/L, all depths)	90% UTL with 95% Coverage (mg/L)	90% UPL (mg/L)	90% USL (mg/L)	95% UTL with 95% Coverage (mg/L)	95% UPL (mg/L)	95% USL (mg/L)	99% UTL with 95% Coverage (mg/L)	99% UPL (mg/L)	99% USL (mg/L)
Arsenic	0.102	0.05	5	0.171	0.0889	5	0.271	0.394	5
Cadmium	0.0147	0.0112	0.0262	0.015	0.0139	0.0275	0.0155	0.0189	0.0303
Chromium, Hexavalent, Dissolved									
Copper	0.0156	0.0139	0.0596	0.0215	0.019	0.0658	0.0363	0.032	0.0807
Cyanide, Dissolved	0.0234	0.0225	0.0263	0.0235	0.0232	0.0266	0.0236	0.0245	0.0273
Lead	0.0357	0.0299	0.216	0.0563	0.0474	0.245	0.114	0.0967	0.314
Mercury	0.000115	0.0000544	0.000597	0.000122	0.00009535	0.000597	0.000126	0.00057289	0.000597
Nickel	0.0306	0.0267	0.13	0.0434	0.0379	0.145	0.0767	0.0669	0.18
Selenium	0.0184	0.0163	0.0681	0.0251	0.0222	0.0751	0.0417	0.0369	0.0917
Silver									
Zinc	12.5	2.976	104	13.4	10.55	104	15.6	58.52	104

Table E-10. Water Based Muds—Solids (mg/kg, all depths)—UTLs, UPLs, and USLs

WBM-S (mg/kg, all depths)	90% UTL with 95% Coverage (mg/kg)	90% UPL (mg/kg)	90% USL (mg/kg)	95% UTL with 95% Coverage (mg/kg)	95% UPL (mg/kg)	95% USL (mg/kg)	99% UTL with 95% Coverage (mg/kg)	99% UPL (mg/kg)	99% USL (mg/kg)
Arsenic	49.97	40.94	119.7	66.51	54.31	132.4	107.2	87.36	161.9
Cadmium	0.736	0.623	1.56	0.938	0.79	1.705	1.417	1.186	2.035
Chromium, Hexavalent	2.339	2.029	4.343	2.865	2.469	4.69	4.067	3.478	5.472
Copper	71.94	60.69	154.3	92.07	77.27	168.8	139.9	116.8	202.1
Cyanide	0.622	0.468	0.893	0.642	0.566	0.942	0.684	0.753	1.043
Lead	375.7	242.9	715.9	396.2	323	792.6	440.3	521.5	970
Mercury	0.459	0.377	1.09	0.609	0.498	1.205	0.977	0.798	1.47
Nickel	9.498	8.024	12.11	9.693	8.963	12.57	10.09	10.76	13.55
Selenium	0.947	0.775	1.252	0.97	0.885	1.306	1.016	1.094	1.42
Silver	0.678	0.428	1.535	0.721	0.574	1.775	0.816	1.005	2.406
Zinc	172.9	122.6	292.9	180.5	153.3	318.9	196.5	225.5	378.1

Table E-11. Water Based Muds—Aqueous (mg/L, all depths)—UTLs, UPLs, and USLs

WBM-A (mg/L, all depths)	90% UTL with 95% Coverage (mg/L)	90% UPL (mg/L)	90% USL (mg/L)	95% UTL with 95% Coverage (mg/L)	95% UPL (mg/L)	95% USL (mg/L)	99% UTL with 95% Coverage (mg/L)	99% UPL (mg/L)	99% USL (mg/L)
Arsenic	0.595	0.383	0.945	0.844	0.546	1.065	1.496	1.001	1.329
Cadmium	0.197	0.136	0.222	0.209	0.167	0.235	0.236	0.228	0.261
Chromium, Hexavalent	0.0132	0.0104	0.0144	0.0138	0.0118	0.015	0.0151	0.0147	0.0162
Copper	1.688	0.965	2.844	2.569	1.504	3.274	5.017	3.118	4.23
Cyanide, Dissolved	0.276	0.189	0.299	0.295	0.232	0.317	0.336	0.318	0.351
Lead	13.24	7.079	24.57	21.19	11.77	28.71	44.16	26.48	38.05
Mercury	0.0135	0.00798	0.0222	0.0201	0.0121	0.0253	0.0382	0.0242	0.0324
Nickel	0.336	0.116	0.517	0.418	0.199	0.653	0.669	0.578	1.031
Selenium	0.0522	0.0381	0.0578	0.055	0.0452	0.0609	0.0612	0.0593	0.0669
Silver									
Zinc	13.4	7.001	24.16	21.56	11.74	28.27	45.28	26.78	37.54

Table E-12. Produced Water (mg/L, all depths)—UTLs, UPLs, and USLs Using Alternative Hawkins-Wixley Method for Gamma Distributed Data

PW (mg/L, all depths)	90% UTL with 95% Coverage (mg/L)	90% UPL (mg/L)	90% USL (mg/L)	95% UTL with 95% Coverage (mg/L)	95% UPL (mg/L)	95% USL (mg/L)	99% UTL with 95% Coverage (mg/L)	99% UPL (mg/L)	99% USL (mg/L)
Arsenic									
Cadmium									
Chromium, Hexavalent, Dissolved									
Copper	0.0134	0.0119	0.0554	0.0186	0.0164	0.0619	0.0322	0.0282	0.0777
Cyanide, Dissolved									
Lead	0.0238	0.0198	0.173	0.0385	0.032	0.2	0.0836	0.0695	0.268
Mercury									
Nickel	0.0271	0.0235	0.135	0.0394	0.0341	0.152	0.0738	0.0634	0.196
Selenium	0.0169	0.0149	0.0707	0.0234	0.0206	0.079	0.0409	0.0357	0.0993
Silver									
Zinc									

Table E-13. Water Based Muds—Solids (mg/kg, all depths)—UTLs, UPLs, and USLs Using Alternative Hawkins-Wixley Method for Gamma Distributed Data

WBM-S (mg/kg, all depths)	90% UTL with 95% Coverage (mg/kg)	90% UPL (mg/kg)	90% USL (mg/kg)	95% UTL with 95% Coverage (mg/kg)	95% UPL (mg/kg)	95% USL (mg/kg)	99% UTL with 95% Coverage (mg/kg)	99% UPL (mg/kg)	99% USL (mg/kg)
Arsenic	51.19	41.1	137.8	70.45	56.15	154.9	121.3	95.95	195.8
Cadmium	0.759	0.632	1.759	0.992	0.819	1.947	1.576	1.289	2.388
Chromium, Hexavalent	2.253	1.951	4.291	2.773	2.38	4.658	4.002	3.394	5.498
Copper	76.25	63.06	182.5	100.8	82.63	202.7	162.9	132.3	250.3
Cyanide									
Lead	415.7	253	882	442	349.6	994.9	499.2	607.9	1265
Mercury	0.499	0.398	1.373	0.692	0.549	1.547	1.206	0.949	1.964
Nickel									
Selenium									
Silver									
Zinc	181.2	124.4	327.1	190	158.7	360.3	208.8	243.5	437.8

Table E-14. Water Based Muds—Aqueous (mg/L, all depths)—UTLs, UPLs, and USLs Using Alternative Hawkins-Wixley Method for Gamma Distributed Data

WBM-A (mg/L, all depths)	90% UTL with 95% Coverage (mg/L)	90% UPL (mg/L)	90% USL (mg/L)	95% UTL with 95% Coverage (mg/L)	95% UPL (mg/L)	95% USL (mg/L)	99% UTL with 95% Coverage (mg/L)	99% UPL (mg/L)	99% USL (mg/L)
Arsenic	0.633	0.383	1.081	0.948	0.574	1.244	1.859	1.156	1.615
Cadmium									
Chromium, Hexavalent									
Copper	1.854	0.955	3.484	3.079	1.616	4.139	6.996	3.899	5.668
Cyanide, Dissolved									
Lead	13.6	6.357	29.19	24.29	11.77	35.44	60.83	32.04	50.45
Mercury	0.0146	0.00789	0.0262	0.0234	0.0128	0.0308	0.0506	0.0292	0.0415
Nickel									
Selenium									
Silver									
Zinc	12.58	5.826	25.71	22.38	10.74	31.17	55.76	29.16	44.2

Table E-15. Water Based Muds—Solids (mg/kg, all depths)—Comparison to Metal Concentrations in Generic Drilling Fluids

Analyte	Metal Concentrations in Generic Drilling Fluids (mg/kg wet weight)		Number of Detects Less Than or Equal to Min. Gen. Drilling Fluid Conc. (#)	Number of Detects Between Min. and Max. Gen. Drilling Fluid Conc. (#)	Number of Detects Greater Than Max. Gen. Drilling Fluid Conc. (#)	Number of Detects Less Than or Equal to Min. Gen. Drilling Fluid Conc. (#)	Number of Detects Between Min. and Max. Gen. Drilling Fluid Conc. (#)	Number of Detects Greater Than Max. Gen. Drilling Fluid Conc. (#)
	Minimum	Maximum						
Arsenic	0.0232	5.50	0	22	54	0	1	0
Cadmium	0.0038	0.229	0	25	35	0	10	7
Chromium, Hexavalent	<0.27	291	0	19	0	0	53	0
Copper	0.063	24.7	0	39	37	0	1	0
Cyanide	No Limit	No Limit	n/a	n/a	n/a	n/a	n/a	n/a
Lead	0.105	16.8	0	16	61	0	0	0
Mercury	<0.00090	0.241	1	52	23	1	0	0
Nickel	<0.54	3.1	1	15	58	1	2	0
Selenium	<0.27	<0.96	8	32	3	24	2	8
Silver	<0.0054	0.445	0	36	6	0	27	8
Zinc	0.203	28.9	0	26	51	0	0	0

Note: Comparisons between generic drilling fluid concentrations reported as "<", are compared to the numerical value. For example a result of 2 was counted as less than the value of <3.

Table E-16. Produced Water (mg/L, all depths) and Water Based Muds—Aqueous (mg/L, all depths)—Comparison of EPA Water Quality Criteria to UCL95s and Calculation of Critical Dilutions

	Selected Thresholds		ProUCL evaluation of upper 95th percentile confidence limit on the mean		Critical Dilution [i.e., threshold/UCL95 with maximum value of 100% effluent]			
	EPA WQC Chronic (mg/L)	EPA WQC Acute (mg/L)	Selected Value (mg/L)	Alter. Value (mg/L)	EPA WQC Chronic / Selected UCL95	EPA WQC Acute / Selected UCL95	EPA WQC Chronic / Alter. UCL95	EPA WQC Acute / Alter. UCL95
PW (mg/L, all depths)								
Arsenic	0.036	0.069	0.0315		100.0%	100.0%	n/a	n/a
Cadmium	0.0088	0.040	0.00311		100.0%	100.0%	n/a	n/a
Chromium, Hexavalent, Dissolved	0.050	1.1	n/a		n/a	n/a	n/a	n/a
Copper	0.0031	0.0048	0.0125	0.0112	24.8%	38.4%	27.7%	42.9%
Cyanide, Dissolved	0.001	0.001	0.0204		4.9%	4.9%	n/a	n/a
Lead	0.0081	0.21	0.0791	0.0506	10.2%	100.0%	16.0%	100.0%
Mercury	0.00094	0.0018	5.9398E-5	5.9853E-5	100.0%	100.0%	100.0%	100.0%
Nickel	0.0082	0.074	0.0188	0.0177	43.6%	100.0%	46.3%	100.0%
Selenium	0.071	0.29	0.0107	0.0105	100.0%	100.0%	100.0%	100.0%
Silver	NL	0.0019	n/a		n/a	n/a	n/a	n/a
Zinc	0.081	0.090	4.569		1.8%	2.0%	n/a	n/a
WBM-A (mg/L, all depths)								
Arsenic	0.036	0.069	0.28	0.352	12.9%	24.6%	10.2%	19.6%
Cadmium	0.0088	0.040	0.0619	0.0619	14.2%	64.6%	14.2%	64.6%
Chromium, Hexavalent	0.050	1.1	0.00705	0.00703	100.0%	100.0%	100.0%	100.0%
Copper	0.0031	0.0048	0.847	0.619	0.4%	0.6%	0.5%	0.8%
Cyanide, Dissolved	0.001	0.001	0.0975		1.0%	1.0%	n/a	n/a
Lead	0.0081	0.21	10.26	5.936	0.1%	2.0%	0.1%	3.5%
Mercury	0.00094	0.0018	0.00704	0.00541	13.4%	25.6%	17.4%	33.3%
Nickel	0.0082	0.074	0.15		5.5%	49.3%	n/a	n/a
Selenium	0.071	0.29	0.0219	0.0213	100.0%	100.0%	100.0%	100.0%
Silver	NL	0.0019	0.0228		n/a	8.3%	n/a	n/a
Zinc	0.081	0.090	14.98	7.64	0.5%	0.6%	1.1%	1.2%

NL: Not listed

n/a: not analyzed

Table E-17. Produced Water (mg/L, all depths) and Water Based Muds—Aqueous (mg/L, all depths)—Comparison of EPA Water Quality Criteria to 95UTL95s and Calculation of Critical Dilutions

	Selected Thresholds		ProUCL evaluation of upper 95th percentile confidence limit on the 95th percentile		Critical Dilution [i.e., threshold/95UTL95 with maximum value of 100% effluent]			
	EPA WQC Chronic (mg/L)	EPA WQC Acute (mg/L)	Selected Value (mg/L)	Alter. Value (mg/L)	EPA WQC Chronic / Selected 95UTL95	EPA WQC Acute / Selected 95UTL95	EPA WQC Chronic / Alter. 95UTL95	EPA WQC Acute / Alter. 95UTL95
PW (mg/L, all depths)								
Arsenic	0.036	0.069	0.171		21.1%	40.4%	n/a	n/a
Cadmium	0.0088	0.040	0.015		58.7%	100.0%	n/a	n/a
Chromium, Hexavalent, Dissolved	0.050	1.1	n/a		n/a	n/a	n/a	n/a
Copper	0.0031	0.0048	0.0215	0.0186	14.4%	22.3%	16.7%	25.8%
Cyanide, Dissolved	0.001	0.001	0.0235		4.3%	4.3%	n/a	n/a
Lead	0.0081	0.21	0.0563	0.0385	14.4%	100.0%	21.0%	100.0%
Mercury	0.00094	0.0018	0.000122		100.0%	100.0%	n/a	n/a
Nickel	0.0082	0.074	0.0434	0.0394	18.9%	100.0%	20.8%	100.0%
Selenium	0.071	0.29	0.0251	0.0234	100.0%	100.0%	100.0%	100.0%
Silver	NL	0.0019	n/a		n/a	n/a	n/a	n/a
Zinc	0.081	0.090	13.4		0.6%	0.7%	n/a	n/a
WBM-A (mg/L, all depths)								
Arsenic	0.036	0.069	0.844	0.948	4.3%	8.2%	3.8%	7.3%
Cadmium	0.0088	0.040	0.209		4.2%	19.1%	n/a	n/a
Chromium, Hexavalent	0.050	1.1	0.0138		100.0%	100.0%	n/a	n/a
Copper	0.0031	0.0048	2.569	3.079	0.1%	0.2%	0.1%	0.2%
Cyanide, Dissolved	0.001	0.001	0.295		0.3%	0.3%	n/a	n/a
Lead	0.0081	0.21	21.19	24.29	0.0%	1.0%	0.0%	0.9%
Mercury	0.00094	0.0018	0.0201	0.0234	4.7%	9.0%	4.0%	7.7%
Nickel	0.0082	0.074	0.418		2.0%	17.7%	n/a	n/a
Selenium	0.071	0.29	0.055		100.0%	100.0%	n/a	n/a
Silver	NL	0.0019	n/a		n/a	n/a	n/a	n/a
Zinc	0.081	0.090	21.56	22.38	0.4%	0.4%	0.4%	0.4%

NL: Not listed

n/a: not analyzed

Table E-18. Comparison Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples Using Kendall's tau correlation coefficient. (For p-values < 0.10, the Akritas-Theil-Sen nonparametric line with Turnbull estimate of intercept is provided.)

Analyte	Matched Samples (#)	Number of Detects for Solids (#)	Number of Detects for Aqueous (#)	Kendall's tau	p-value	Slope	Intercept
Arsenic	13	13	10	0.4359	0.037	0.0012123	0.0102
Cadmium	13	11	3	0.23077	0.240	--	--
Chromium, Hexavalent	12	5	4	0.045455	0.851	--	--
Copper	12	12	5	0.090909	0.710	--	--
Cyanide	9	1	1	n/a	n/a	--	--
Lead	13	13	6	0.44872	0.029	0.011572	-0.16196
Mercury	12	12	6	0.34848	0.096	0.0066398	-0.000033568
Nickel	13	13	6	0.35897	0.074	0.022236	-0.071495
Selenium	13	10	4	-0.11538	0.584	-0.022632	0.020653
Silver	13	6	0	n/a	n/a	--	--
Zinc	12	12	4	0.36364	0.084	0.013255	-0.28381

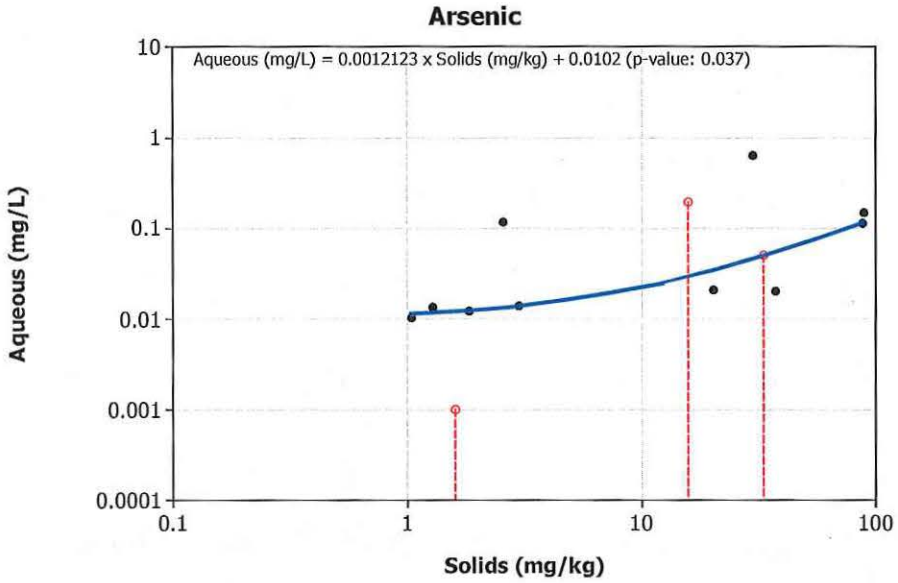


Figure E-1. Arsenic—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect; blue line: Akritas-Theil-Sen nonparametric line with Turnbull estimate of intercept.)

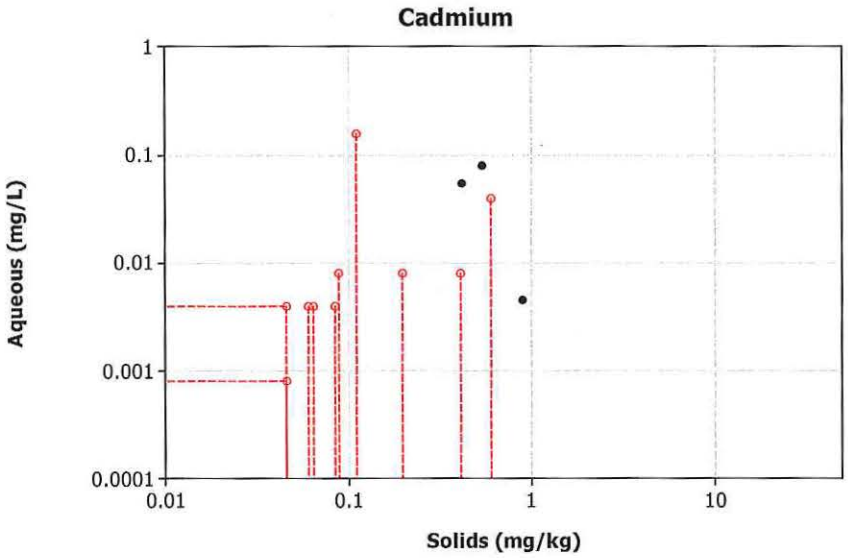


Figure E-2. Cadmium—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect.)

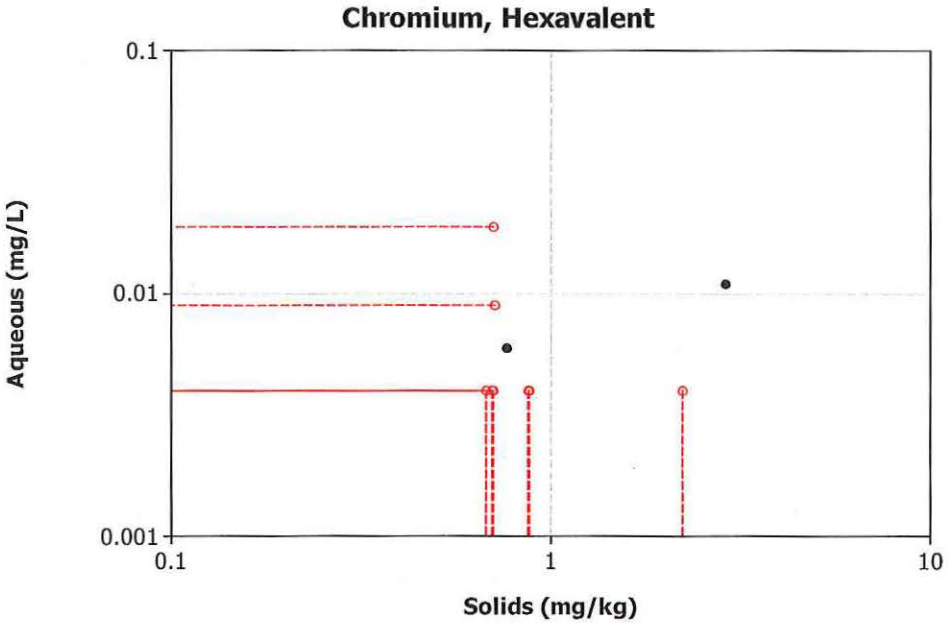


Figure E-3. Chromium, Hexavalent—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect.)

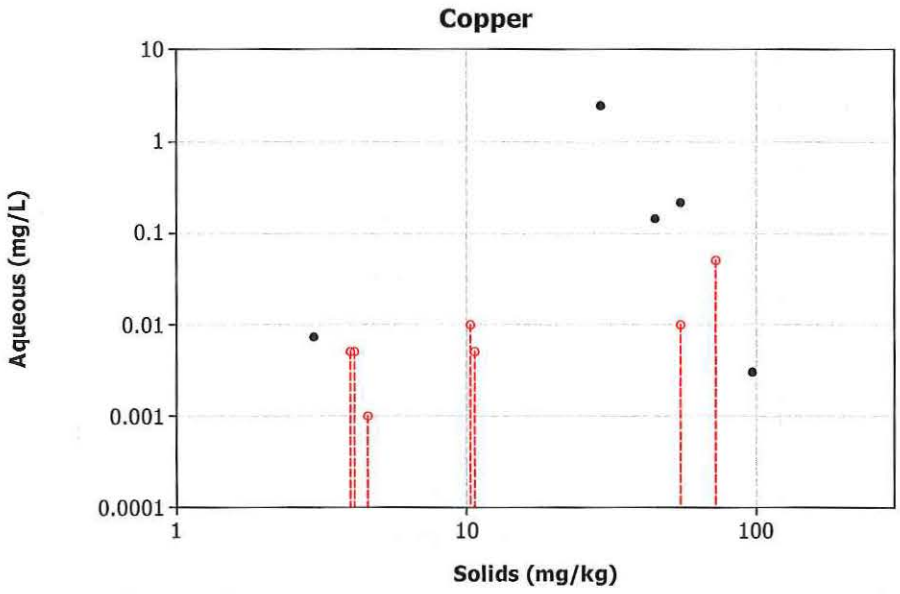


Figure E-4. Copper—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect.)

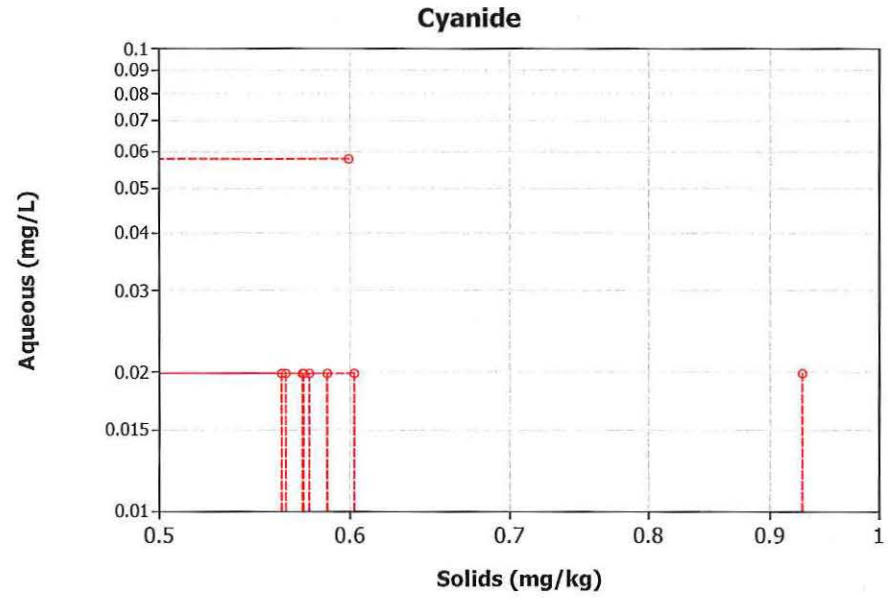


Figure E-5. Cyanide—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect.)

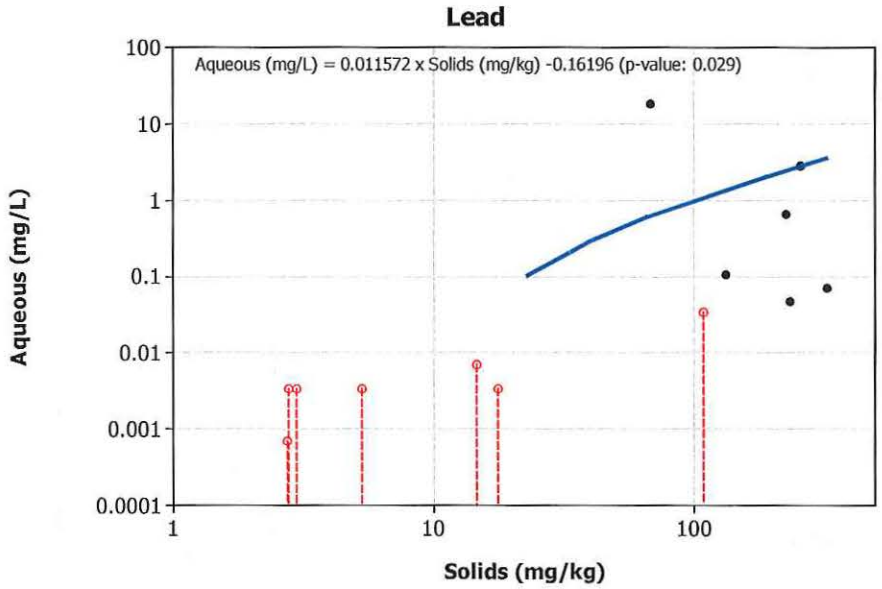


Figure E-6. Lead—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect.)

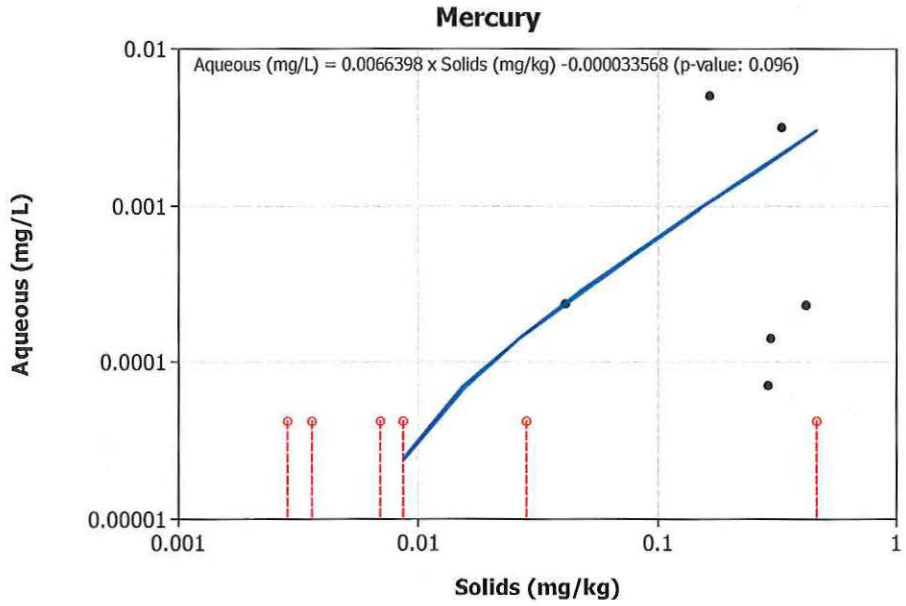


Figure E-7. Mercury—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect; blue line: Akritas-Theil-Sen nonparametric line with Turnbull estimate of intercept.)

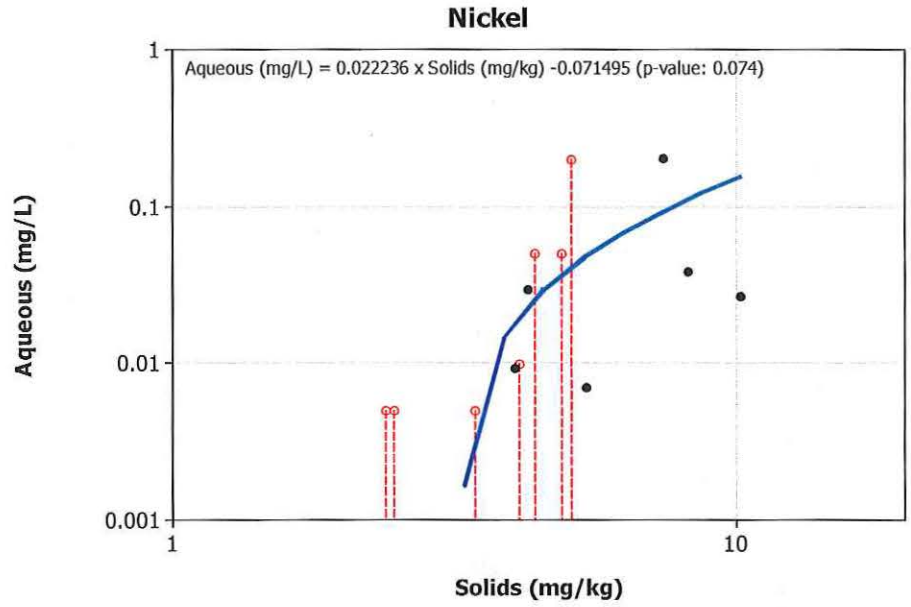


Figure E-8. Nickel—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect; blue line: Akritas-Theil-Sen nonparametric line with Turnbull estimate of intercept.)

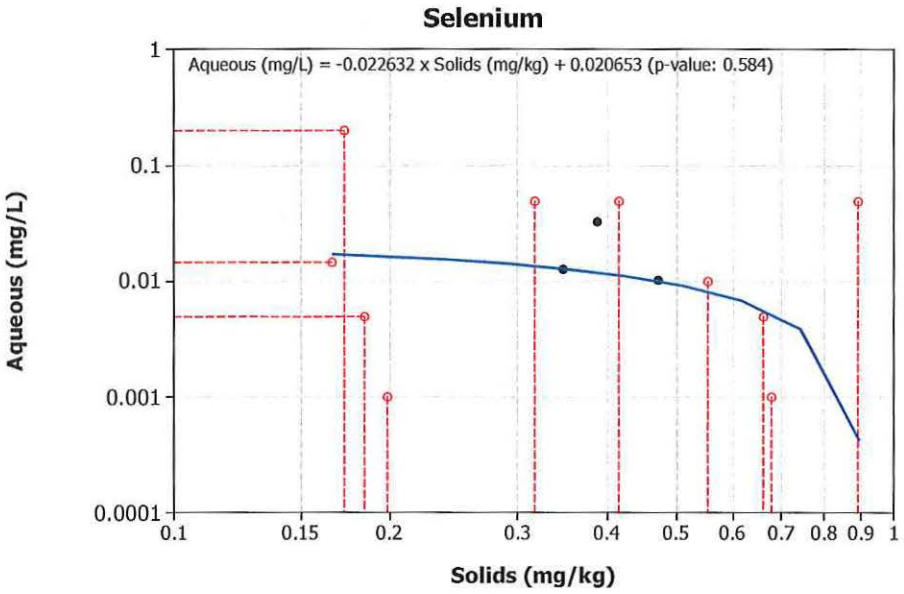


Figure E-9. Selenium—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect; blue line: Akritas-Theil-Sen nonparametric line with Turnbull estimate of intercept.)

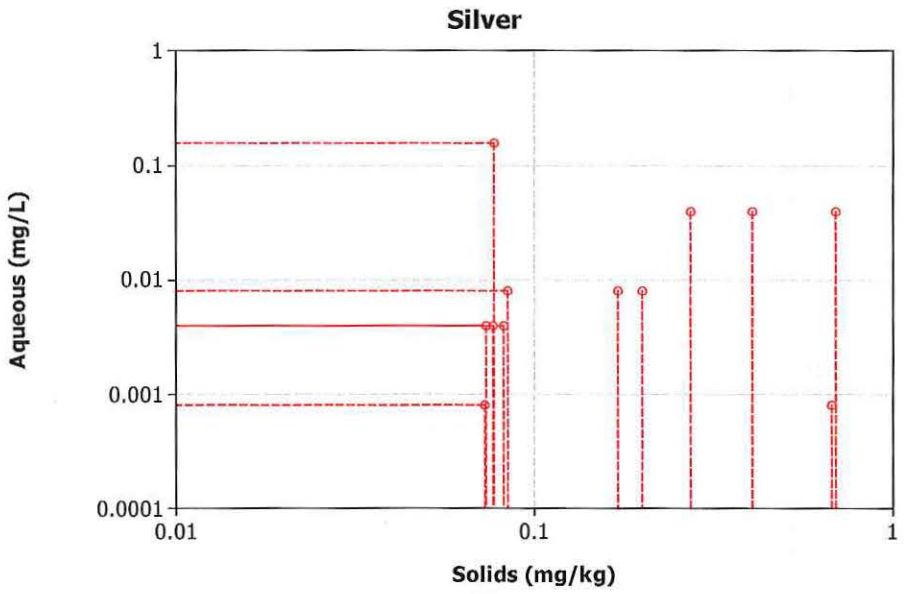


Figure E-10. Silver—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect.)

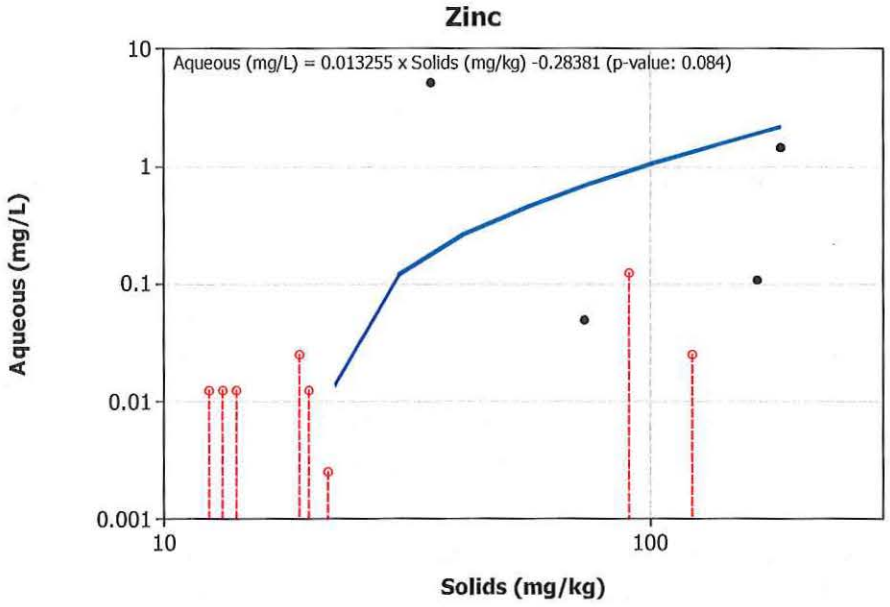


Figure E-11. Zinc—Matched Water Based Muds—Solids and Water Based Muds—Aqueous Samples.

(Black circles: solid and aqueous sample are both detects; open red circle with vertical dashed line: aqueous sample is non-detect; open red circle with horizontal dashed line: solids sample is non-detect; blue line: Akritas-Theil-Sen nonparametric line with Turnbull estimate of intercept.)

E-5. Chemical-specific Summaries

E-5.1 Produced Water

Arsenic. The arsenic PW data set includes 273 observations with 241 (88.3%) non-detected results. The detected results range from 0.00224 to 0.594 mg/L. The modified MDL of the 241 non-detected results range from 0.001 to 5 mg/L. See Figure E-12 for general statistics and a time series plot of the available data.

The overall mean of the arsenic PW data set concentrations using the Kaplan Meier method is 0.0161 mg/L. Goodness of fit tests implemented using ProUCL indicated that the arsenic PW data set did not follow a particular distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.0315 mg/L. The upper prediction limit for the arsenic PW data set at the 95% confidence level is 0.0889 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.171 mg/L. The upper simultaneous limit is 5 mg/L.

Cadmium. The cadmium PW data set includes 277 observations with 274 (98.9%) non-detected results. The 3 detected results range from 0.0197 to 0.102 mg/L. The modified MDL of the 274 non-detected results range from 0.0008 to 2.5 mg/L. See Figure E-13 for general statistics and a time series plot of the available data.

The overall mean of the cadmium PW data set concentrations using the Kaplan Meier method is 0.00187 mg/L. Goodness of fit tests implemented using ProUCL indicated that the cadmium PW data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.00311 mg/L. The upper prediction limit for the cadmium PW data set at the 95% confidence level is 0.0139 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.015 mg/L. The upper simultaneous limit is 0.0275 mg/L.

Chromium, Hexavalent, Dissolved. The dissolved hexavalent chromium PW data set includes 244 observations with 243 (99.6%) non-detected results. The 1 detected result is 0.0219 mg/L. The modified MDL of the 243 non-detected results range from 0.00002 to 0.001 mg/L. See Figure E-14 for general statistics and a time series plot of the available data.

The overall mean of the dissolved hexavalent chromium PW data set concentrations using the Kaplan Meier method is 0.00010967 mg/L. There are insufficient detected observations to determine the distribution of the data using goodness of fit tests. There are insufficient detected observations to estimate the upper prediction, tolerance or simultaneous limits.

Copper. The copper PW data set includes 274 observations with 262 (95.6%) non-detected results. The 12 detected results range from 0.00178 to 0.332 mg/L. The modified MDL of the 262 non-detected results range from 0.001 to 5 mg/L. See Figure E-15 for general statistics and a time series plot of the available data.

The overall mean of the copper PW data set concentrations using the Kaplan Meier method is 0.00747 mg/L. Goodness of fit tests implemented using ProUCL indicated that the copper PW data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile

confidence limit on the mean is estimated using ProUCL as 0.0125 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.0112 mg/L is also suggested by ProUCL. The upper prediction limit for the copper PW data set at the 95% confidence level is 0.019 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.0215 mg/L. The upper simultaneous limit is 0.0658 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 0.0164, 0.0186, and 0.0619 mg/L, respectively.

Cyanide, Dissolved. The dissolved cyanide PW data set includes 269 observations with 265 (98.5%) non-detected results. The 4 detected results range from 0.022 to 0.0415 mg/L. The modified MDL of the 265 non-detected results range from 0.02 to 0.02 mg/L. See Figure E-16 for general statistics and a time series plot of the available data.

The overall mean of the dissolved cyanide PW data set concentrations using the Kaplan Meier method is 0.0202 mg/L. Goodness of fit tests implemented using ProUCL indicated that the dissolved cyanide PW data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.0204 mg/L. The upper prediction limit for the dissolved cyanide PW data set at the 95% confidence level is 0.0232 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.0235 mg/L. The upper simultaneous limit is 0.0266 mg/L.

Lead. The lead PW data set includes 277 observations with 263 (95%) non-detected results. The 14 detected results range from 0.00175 to 3.27 mg/L. The modified MDL of the 263 non-detected results range from 0.0007 to 2.5 mg/L. See Figure E-17 for general statistics and a time series plot of the available data.

The overall mean of the lead PW data set concentrations using the Kaplan Meier method is 0.0273 mg/L. Goodness of fit tests implemented using ProUCL indicated that the lead PW data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.0791 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.0506 mg/L is also suggested by ProUCL. The upper prediction limit for the lead PW data set at the 95% confidence level is 0.0474 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.0563 mg/L. The upper simultaneous limit is 0.245 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 0.032, 0.0385, and 0.2 mg/L, respectively.

Mercury. The mercury PW data set includes 272 observations with 235 (86.4%) non-detected results. The 37 detected results range from 0.000043 to 0.000597 mg/L. The modified MDL of the 235 non-detected results range from 0.000042 to 0.000042 mg/L. See Figure E-18 for general statistics and a time series plot of the available data.

The overall mean of the mercury PW data set concentrations using the Kaplan Meier method is 0.000053294 mg/L. Goodness of fit tests implemented using ProUCL indicated that the mercury PW data set did not follow a particular distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.000059398 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.000059853 mg/L is also suggested by ProUCL. The upper prediction limit for the mercury PW data set at the 95% confidence

level is 0.00009535 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.000122 mg/L. The upper simultaneous limit is 0.000597 mg/L.

Nickel. The nickel PW data set includes 271 observations with 245 (90.4%) non-detected results. The 26 detected results range from 0.00194 to 0.374 mg/L. The modified MDL of the 245 non-detected results range from 0.005 to 4.5 mg/L. See Figure E-19 for general statistics and a time series plot of the available data.

The overall mean of the nickel PW data set concentrations using the Kaplan Meier method is 0.0131 mg/L. Goodness of fit tests implemented using ProUCL indicated that the nickel PW data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.0188 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.0177 mg/L is also suggested by ProUCL. The upper prediction limit for the nickel PW data set at the 95% confidence level is 0.0379 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.0434 mg/L. The upper simultaneous limit is 0.145 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 0.0341, 0.0394, and 0.152 mg/L, respectively.

Selenium. The selenium PW data set includes 277 observations with 256 (92.4%) non-detected results. The 21 detected results range from 0.00177 to 0.257 mg/L. The modified MDL of the 256 non-detected results range from 0.001 to 9 mg/L. See Figure E-20 for general statistics and a time series plot of the available data.

The overall mean of the selenium PW data set concentrations using the Kaplan Meier method is 0.00782 mg/L. Goodness of fit tests implemented using ProUCL indicated that the selenium PW data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.0107 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.0105 mg/L is also suggested by ProUCL. The upper prediction limit for the selenium PW data set at the 95% confidence level is 0.0222 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.0251 mg/L. The upper simultaneous limit is 0.0751 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 0.0206, 0.0234, and 0.079 mg/L, respectively.

Silver. The silver PW data set includes 277 observations with 277 (100%) non-detected results. The modified MDL of the 277 non-detected results range from 0.0008 to 4 mg/L. The modified MDL for 74% (204 of 277) of the non-detected results was 0.04 mg/L and the modified MDL of all 270 results is greater than the corresponding acute marine water quality criteria of 0.0019 mg/L. See Figure E-21 for general statistics and a time series plot of the available data.

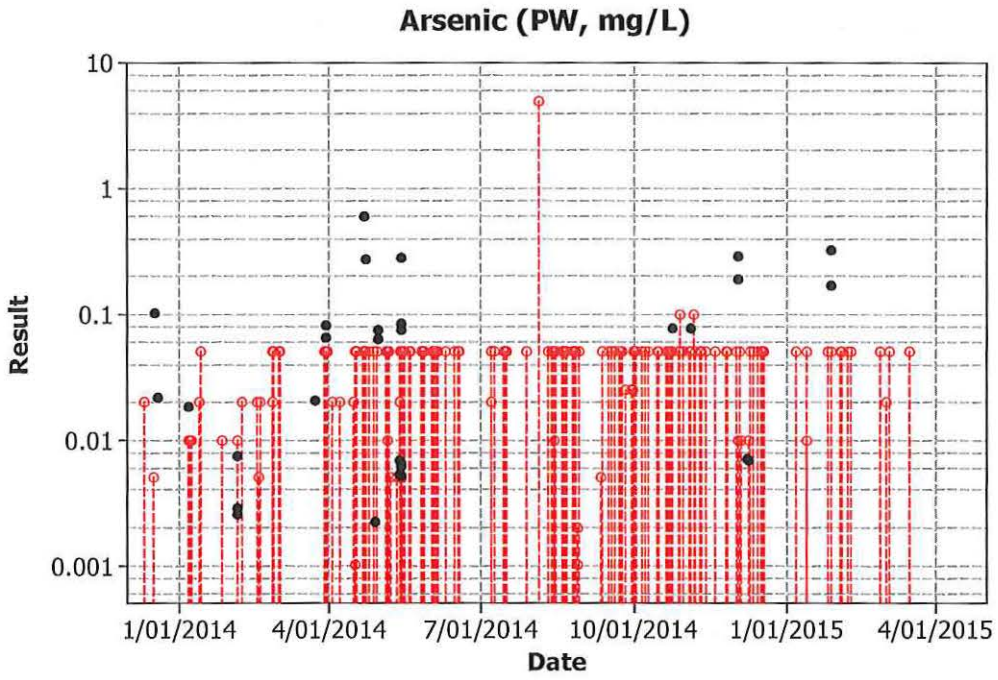
The overall mean of the silver PW data set concentrations could not be estimated using the Kaplan Meier method. There are zero detected observations to determine the distribution of the data using goodness of fit tests. There are zero detected observations to estimate the upper prediction, tolerance or simultaneous limits.

Zinc. The zinc PW data set includes 277 observations with 153 (55.2%) non-detected results. The 124 detected results range from 0.0106 to 104 mg/L. The modified MDL of the 153 non-detected results range from 0.0125 to 12.5 mg/L. See Figure E-22 for general statistics and a time series plot of the available data.

The overall mean of the zinc PW data set concentrations using the Kaplan Meier method is 2.092 mg/L. Goodness of fit tests implemented using ProUCL indicated that the zinc PW data set did not follow a particular distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 4.569 mg/L. The upper prediction limit for the zinc PW data set at the 95% confidence level is 10.55 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 13.4 mg/L. The upper simultaneous limit is 104 mg/L.

Figure E-12. Arsenic (PW, mg/L) General Statistics and Time Series

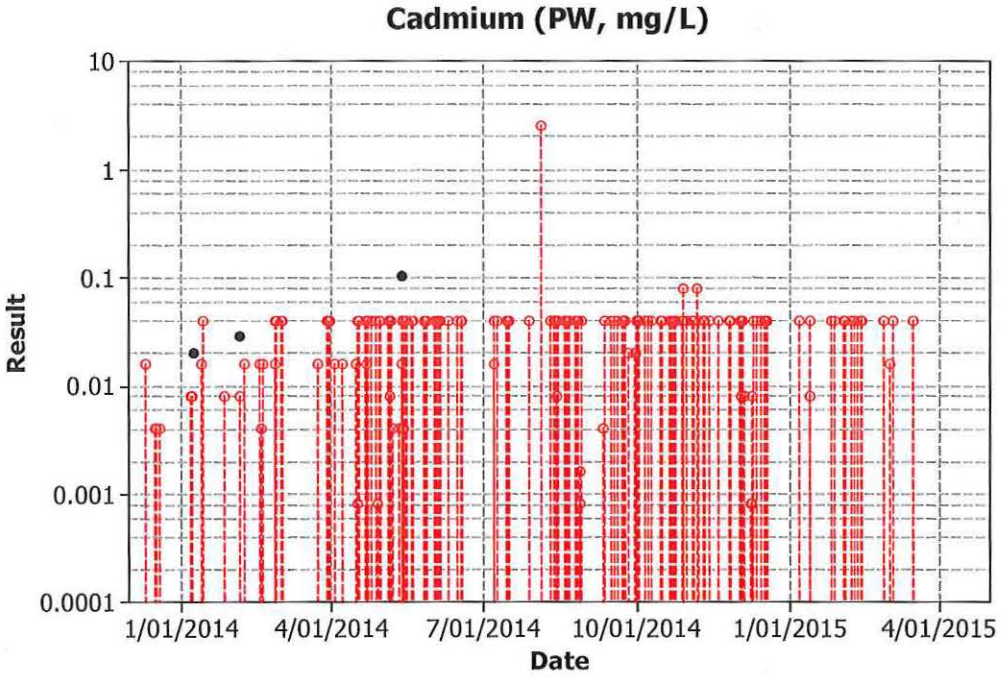
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Arsenic)			
Total Number of Observations (#)	273	Number of Distinct Observations (#)	41
Number of Detects (#)	32	Number of Non-Detects (#)	241
Number of Distinct Detects (#)	32	Number of Distinct Non-Detects (#)	9
Minimum Detect (mg/L)	0.00224	Minimum Non-Detect (mg/L)	0.001
Maximum Detect (mg/L)	0.594	Maximum Non-Detect (mg/L)	5
Variance Detects $(mg/L)^2$	0.0182	Percent Non-Detects (%)	88.28%
Mean Detects (mg/L)	0.106	SD Detects (mg/L)	0.135
Median Detects (mg/L)	0.0695	CV Detects	1.274
Skewness Detects	1.906	Kurtosis Detects	4.296
Mean of Logged Detects (log[mg/L])	-3.285	SD of Logged Detects (log[mg/L])	1.69

Figure E-13. Cadmium (PW, mg/L) General Statistics and Time Series

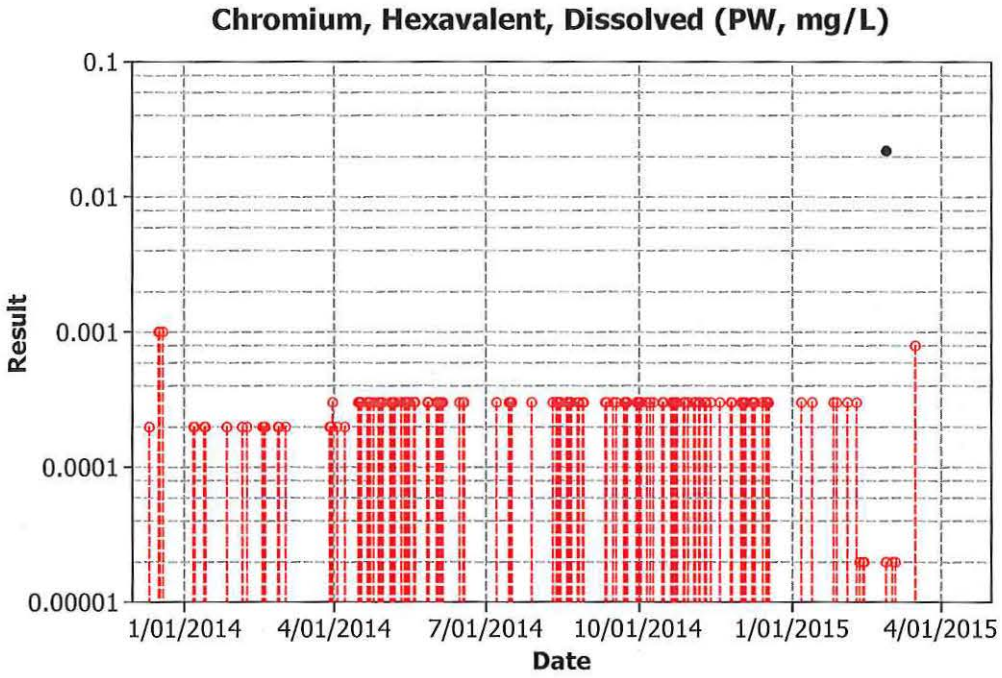
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Cadmium)			
Total Number of Observations (#)	277	Number of Distinct Observations (#)	12
Number of Detects (#)	3	Number of Non-Detects (#)	274
Number of Distinct Detects (#)	3	Number of Distinct Non-Detects (#)	9
Minimum Detect (mg/L)	0.0197	Minimum Non-Detect (mg/L)	8.00E-04
Maximum Detect (mg/L)	0.102	Maximum Non-Detect (mg/L)	2.5
Variance Detects $(mg/L)^2$	0.00204	Percent Non-Detects (%)	98.92%
Mean Detects (mg/L)	0.0501	SD Detects (mg/L)	0.0452
Median Detects (mg/L)	0.0285	CV Detects	0.903
Skewness Detects	1.658	Kurtosis Detects	N/A
Mean of Logged Detects (log[mg/L])	-3.256	SD of Logged Detects (log[mg/L])	0.863

Figure E-14. Chromium, hexavalent, dissolved (PW, mg/L) General Statistics and Time Series

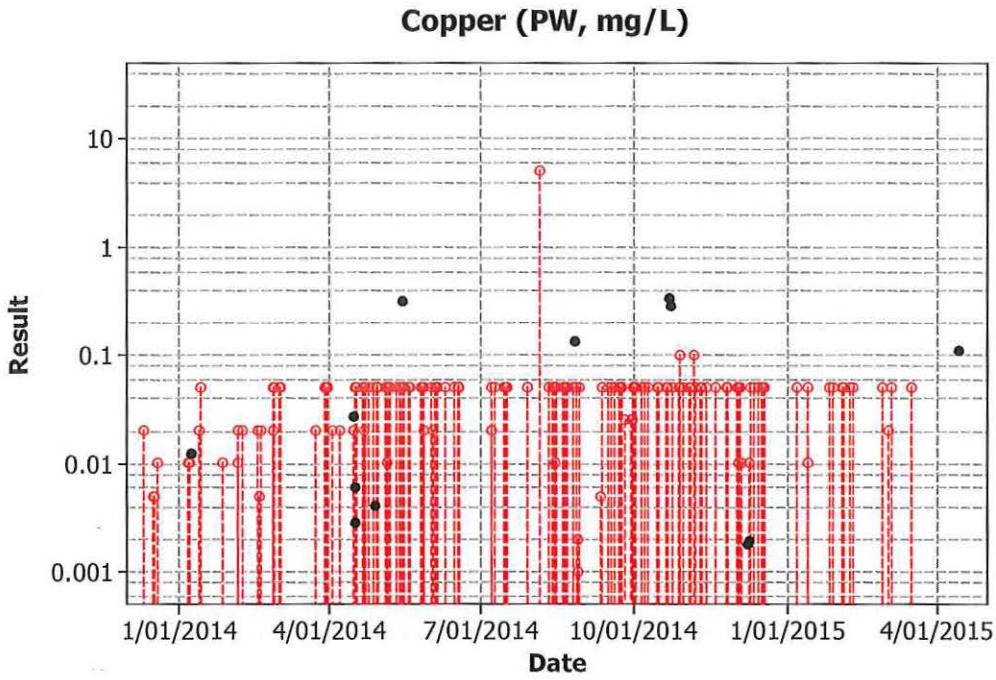
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Chromium, hexavalent, dissolved)			
Total Number of Observations (#)	244	Number of Distinct Observations (#)	6
Number of Detects (#)	1	Number of Non-Detects (#)	243
Number of Distinct Detects (#)	1	Number of Distinct Non-Detects (#)	5
Minimum Detect (mg/L)	0.0219	Minimum Non-Detect (mg/L)	2.00E-05
Maximum Detect (mg/L)	0.0219	Maximum Non-Detect (mg/L)	0.001
Variance Detects $(mg/L)^2$	-	Percent Non-Detects (%)	99.59%
Mean Detects (mg/L)	-	SD Detects (mg/L)	-
Median Detects (mg/L)	-	CV Detects	-
Skewness Detects	-	Kurtosis Detects	-
Mean of Logged Detects (log[mg/L])	-	SD of Logged Detects (log[mg/L])	-

Figure E-15. Copper (PW, mg/L) General Statistics and Time Series

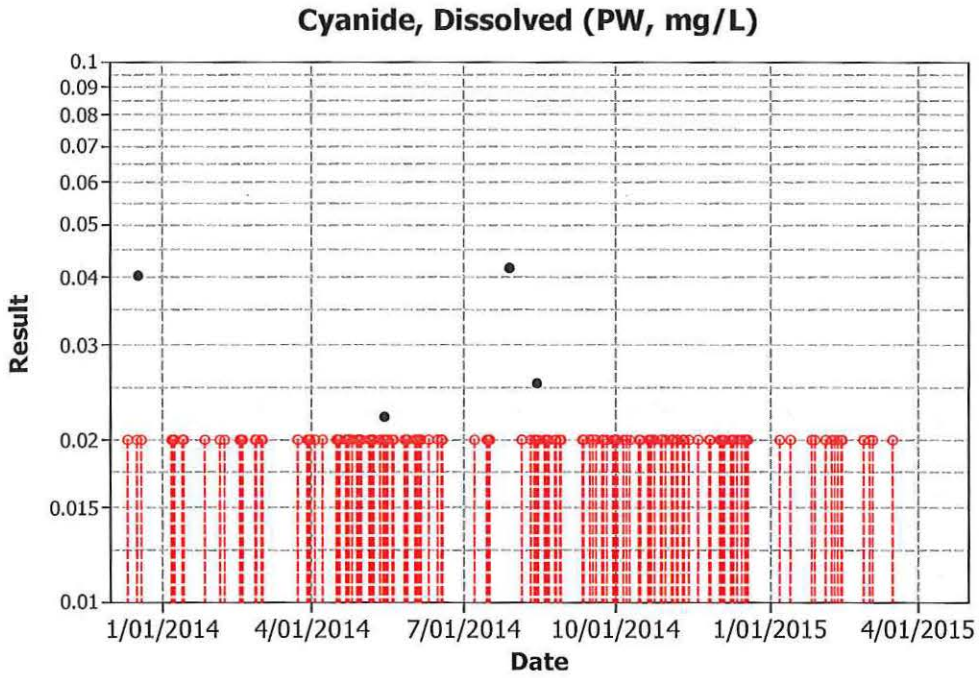
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Copper)			
Total Number of Observations (#)	274	Number of Distinct Observations (#)	21
Number of Detects (#)	12	Number of Non-Detects (#)	262
Number of Distinct Detects (#)	12	Number of Distinct Non-Detects (#)	9
Minimum Detect (mg/L)	0.00178	Minimum Non-Detect (mg/L)	0.001
Maximum Detect (mg/L)	0.332	Maximum Non-Detect (mg/L)	5
Variance Detects $(mg/L)^2$	0.0176	Percent Non-Detects (%)	95.62%
Mean Detects (mg/L)	0.102	SD Detects (mg/L)	0.133
Median Detects (mg/L)	0.0196	CV Detects	1.298
Skewness Detects	1	Kurtosis Detects	-0.781
Mean of Logged Detects (log[mg/L])	-3.737	SD of Logged Detects (log[mg/L])	2.092

Figure E-16. Cyanide, dissolved (PW, mg/L) General Statistics and Time Series

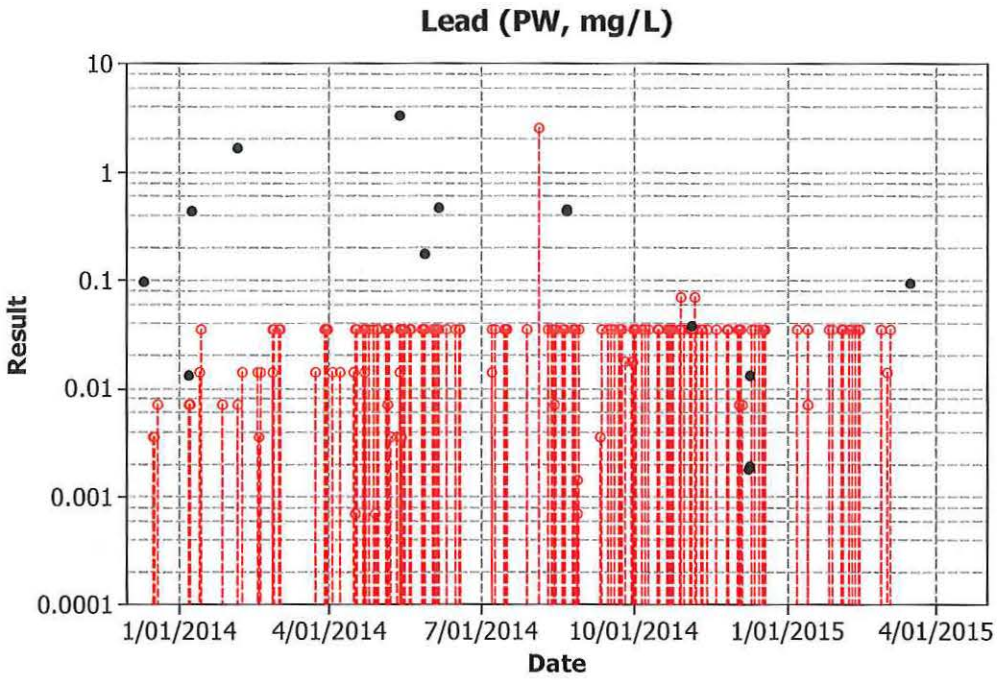
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Cyanide, dissolved)			
Total Number of Observations (#)	269	Number of Distinct Observations (#)	5
Number of Detects (#)	4	Number of Non-Detects (#)	265
Number of Distinct Detects (#)	4	Number of Distinct Non-Detects (#)	1
Minimum Detect (mg/L)	0.022	Minimum Non-Detect (mg/L)	0.02
Maximum Detect (mg/L)	0.0415	Maximum Non-Detect (mg/L)	0.02
Variance Detects $(mg/L)^2$	1.01E-04	Percent Non-Detects (%)	98.51%
Mean Detects (mg/L)	0.0324	SD Detects (mg/L)	0.01
Median Detects (mg/L)	0.033	CV Detects	0.31
Skewness Detects	-0.0937	Kurtosis Detects	-5.345
Mean of Logged Detects (log[mg/L])	-3.469	SD of Logged Detects (log[mg/L])	0.322

Figure E-17. Lead (PW, mg/L) General Statistics and Time Series

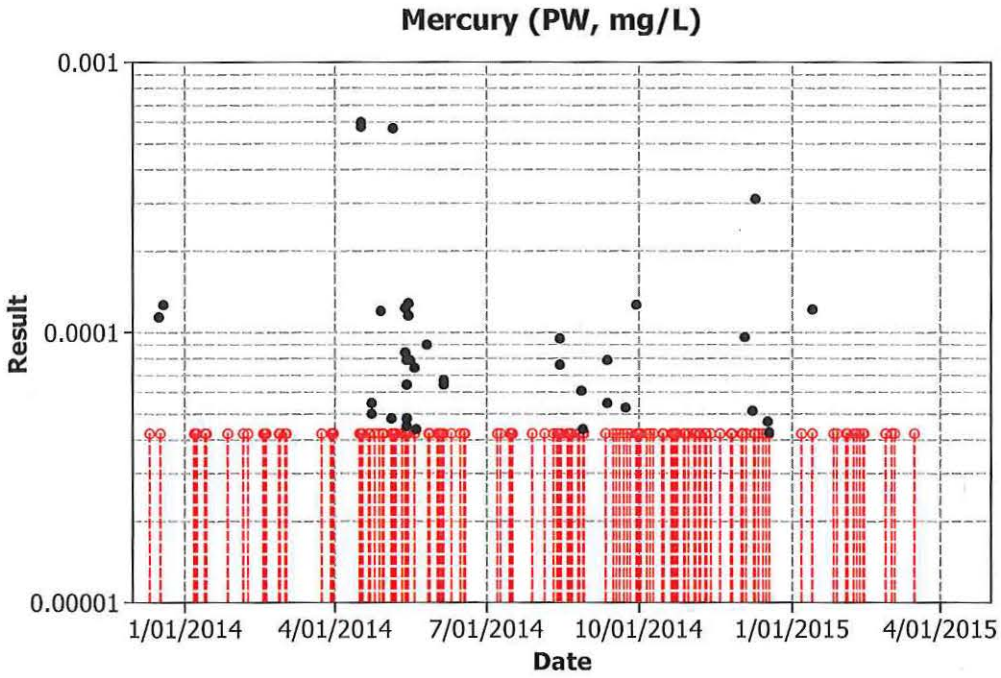
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Lead)			
Total Number of Observations (#)	277	Number of Distinct Observations (#)	23
Number of Detects (#)	14	Number of Non-Detects (#)	263
Number of Distinct Detects (#)	14	Number of Distinct Non-Detects (#)	9
Minimum Detect (mg/L)	0.00175	Minimum Non-Detect (mg/L)	7.00E-04
Maximum Detect (mg/L)	3.27	Maximum Non-Detect (mg/L)	2.5
Variance Detects $(mg/L)^2$	0.821	Percent Non-Detects (%)	94.95%
Mean Detects (mg/L)	0.51	SD Detects (mg/L)	0.906
Median Detects (mg/L)	0.133	CV Detects	1.778
Skewness Detects	2.628	Kurtosis Detects	7.089
Mean of Logged Detects (log[mg/L])	-2.333	SD of Logged Detects (log[mg/L])	2.331

Figure E-18. Mercury (PW, mg/L) General Statistics and Time Series

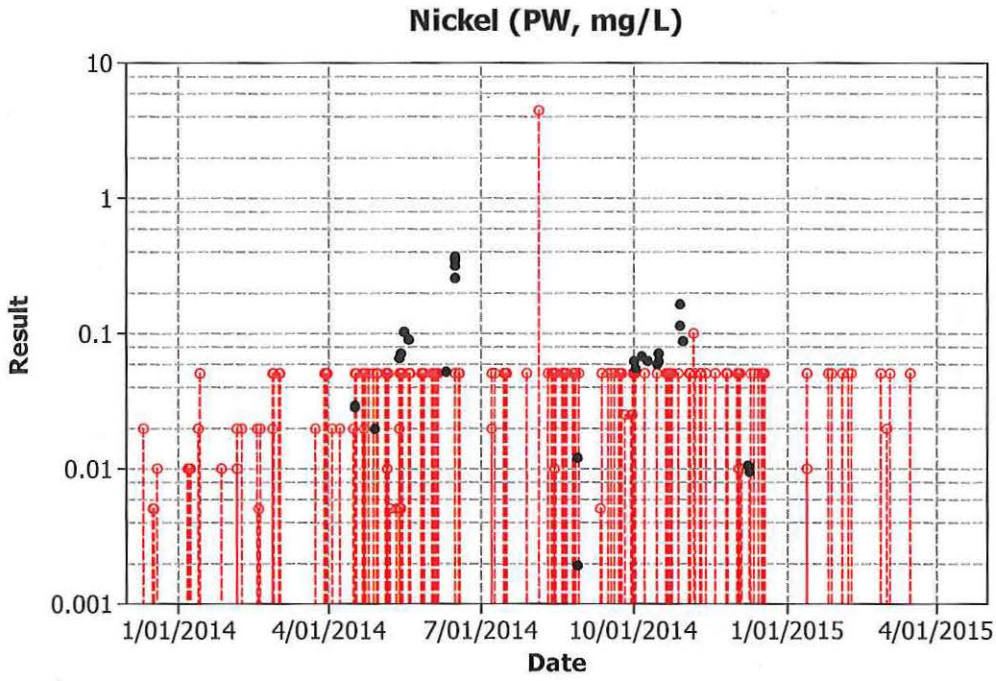
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Mercury)			
Total Number of Observations (#)	272	Number of Distinct Observations (#)	32
Number of Detects (#)	37	Number of Non-Detects (#)	235
Number of Distinct Detects (#)	31	Number of Distinct Non-Detects (#)	1
Minimum Detect (mg/L)	4.30E-05	Minimum Non-Detect (mg/L)	4.20E-05
Maximum Detect (mg/L)	5.97E-04	Maximum Non-Detect (mg/L)	4.20E-05
Variance Detects $(mg/L)^2$	2.12E-08	Percent Non-Detects (%)	86.40%
Mean Detects (mg/L)	1.25E-04	SD Detects (mg/L)	1.46E-04
Median Detects (mg/L)	7.90E-05	CV Detects	1.165
Skewness Detects	2.721	Kurtosis Detects	6.427
Mean of Logged Detects (log[mg/L])	-9.322	SD of Logged Detects (log[mg/L])	0.708

Figure E-19. Nickel (PW, mg/L) General Statistics and Time Series

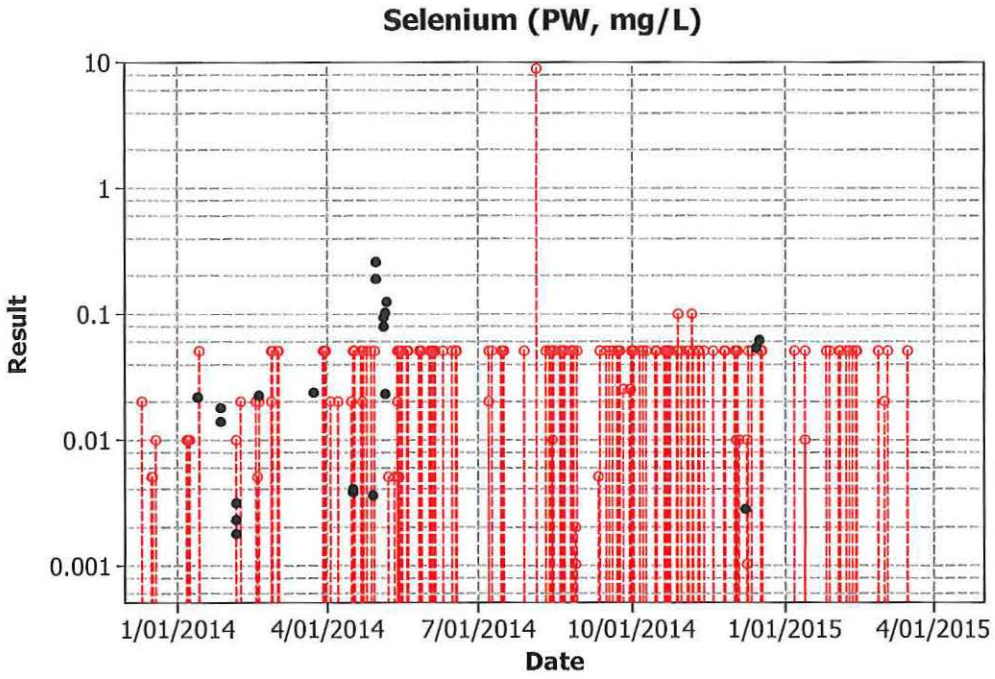
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Nickel)			
Total Number of Observations (#)	271	Number of Distinct Observations (#)	33
Number of Detects (#)	26	Number of Non-Detects (#)	245
Number of Distinct Detects (#)	26	Number of Distinct Non-Detects (#)	7
Minimum Detect (mg/L)	0.00194	Minimum Non-Detect (mg/L)	0.005
Maximum Detect (mg/L)	0.374	Maximum Non-Detect (mg/L)	4.5
Variance Detects $(mg/L)^2$	0.0111	Percent Non-Detects (%)	90.41%
Mean Detects (mg/L)	0.0997	SD Detects (mg/L)	0.105
Median Detects (mg/L)	0.0646	CV Detects	1.055
Skewness Detects	1.695	Kurtosis Detects	1.892
Mean of Logged Detects (log[mg/L])	-2.856	SD of Logged Detects (log[mg/L])	1.207

Figure E-20. Selenium (PW, mg/L) General Statistics and Time Series

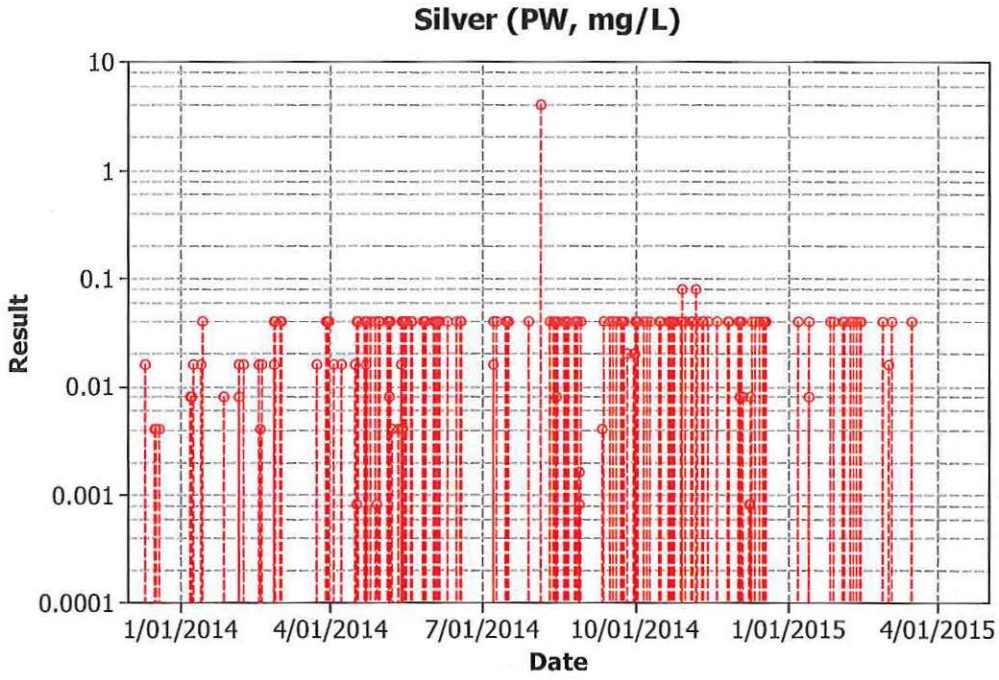
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Selenium)			
Total Number of Observations (#)	277	Number of Distinct Observations (#)	30
Number of Detects (#)	21	Number of Non-Detects (#)	256
Number of Distinct Detects (#)	21	Number of Distinct Non-Detects (#)	9
Minimum Detect (mg/L)	0.00177	Minimum Non-Detect (mg/L)	0.001
Maximum Detect (mg/L)	0.257	Maximum Non-Detect (mg/L)	9
Variance Detects $(mg/L)^2$	0.00469	Percent Non-Detects (%)	92.42%
Mean Detects (mg/L)	0.0524	SD Detects (mg/L)	0.0685
Median Detects (mg/L)	0.0222	CV Detects	1.308
Skewness Detects	1.835	Kurtosis Detects	3.216
Mean of Logged Detects (log[mg/L])	-3.92	SD of Logged Detects (log[mg/L])	1.586

Figure E-21. Silver (PW, mg/L) General Statistics and Time Series

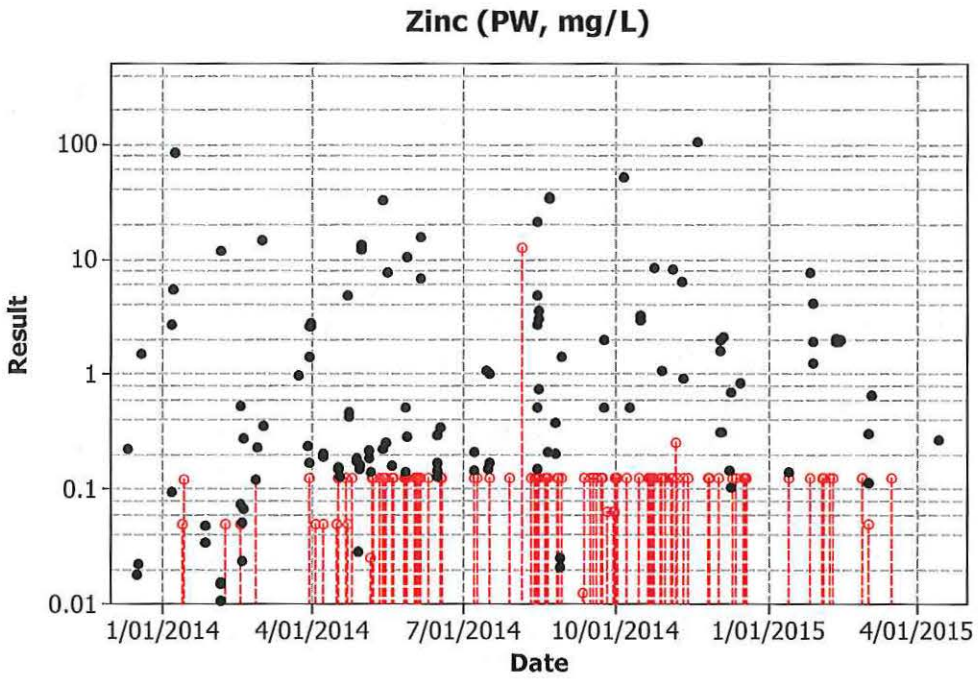
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Silver)			
Total Number of Observations (#)	277	Number of Distinct Observations (#)	9
Number of Detects (#)	0	Number of Non-Detects (#)	277
Number of Distinct Detects (#)	0	Number of Distinct Non-Detects (#)	9
Minimum Detect (mg/L)	-	Minimum Non-Detect (mg/L)	8.00E-04
Maximum Detect (mg/L)	-	Maximum Non-Detect (mg/L)	4
Variance Detects $(mg/L)^2$	-	Percent Non-Detects (%)	100.00%
Mean Detects (mg/L)	-	SD Detects (mg/L)	-
Median Detects (mg/L)	-	CV Detects	-
Skewness Detects	-	Kurtosis Detects	-
Mean of Logged Detects (log[mg/L])	-	SD of Logged Detects (log[mg/L])	-

Figure E-22. Zinc (PW, mg/L) General Statistics and Time Series

(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Zinc)			
Total Number of Observations (#)	277	Number of Distinct Observations (#)	126
Number of Detects (#)	124	Number of Non-Detects (#)	153
Number of Distinct Detects (#)	118	Number of Distinct Non-Detects (#)	8
Minimum Detect (mg/L)	0.0106	Minimum Non-Detect (mg/L)	0.0125
Maximum Detect (mg/L)	104	Maximum Non-Detect (mg/L)	12.5
Variance Detects $(mg/L)^2$	188.2	Percent Non-Detects (%)	55.23%
Mean Detects (mg/L)	4.627	SD Detects (mg/L)	13.72
Median Detects (mg/L)	0.398	CV Detects	2.964
Skewness Detects	5.269	Kurtosis Detects	31.41
Mean of Logged Detects (log[mg/L])	-0.484	SD of Logged Detects (log[mg/L])	2.001

E-5.2 Water Based Muds–Solids

Arsenic. The arsenic WBM-S data set includes 77 observations with 1 (1.3%) non-detected result. The 76 detected results range from 0.295 to 225 mg/kg. The modified MDL of the 1 non-detected result is 0.0954 mg/kg. See Figure E-23 for general statistics and a time series plot of the available data.

The overall mean of the arsenic WBM-S data set concentrations using the Kaplan Meier method is 17.99 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the arsenic WBM-S data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 24.94 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 32.32 mg/kg is also suggested by ProUCL. The upper prediction limit for the arsenic WBM-S data set at the 95% confidence level is 54.31 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 66.51 mg/kg. The upper simultaneous limit is 132.4 mg/kg. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 56.15, 70.45, and 154.9 mg/kg, respectively.

Cadmium. The cadmium WBM-S data set includes 77 observations with 17 (22.1%) non-detected results. The 60 detected results range from 0.0566 to 1.13 mg/kg. The modified MDL of the 17 non-detected results range from 0.0452 to 0.553 mg/kg. See Figure E-24 for general statistics and a time series plot of the available data.

The overall mean of the cadmium WBM-S data set concentrations using the Kaplan Meier method is 0.293 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the cadmium WBM-S data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.345 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.337 mg/kg is also suggested by ProUCL. The upper prediction limit for the cadmium WBM-S data set at the 95% confidence level is 0.79 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.938 mg/kg. The upper simultaneous limit is 1.705 mg/kg. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 0.819, 0.992, and 1.947 mg/kg, respectively.

Chromium, Hexavalent. The hexavalent chromium WBM-S data set includes 72 observations with 53 (73.6%) non-detected results. The 19 detected results range from 0.714 to 11.4 mg/kg. The modified MDL of the 53 non-detected results range from 0.67 to 1.76 mg/kg. See Figure E-25 for general statistics and a time series plot of the available data.

The overall mean of the hexavalent chromium WBM-S data set concentrations using the Kaplan Meier method is 1.101 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the hexavalent chromium WBM-S data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 1.437 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 1.384 mg/kg is also suggested by ProUCL. The upper prediction limit for the hexavalent chromium WBM-S data set at the 95% confidence level is 2.469 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 2.865 mg/kg. The upper simultaneous limit is 4.69 mg/kg. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 2.38, 2.773, and 4.658 mg/kg, respectively.

Copper. The copper WBM-S data set includes 77 observations with 1 (1.3%) non-detected result. The 76 detected results range from 0.557 to 97.1 mg/kg. The modified MDL of the 1 non-detected result is 0.0954 mg/kg. See Figure E-26 for general statistics and a time series plot of the available data.

The overall mean of the copper WBM-S data set concentrations using the Kaplan Meier method is 27.92 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the copper WBM-S data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 32.57 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 38.9 mg/kg is also suggested by ProUCL. The upper prediction limit for the copper WBM-S data set at the 95% confidence level is 77.27 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 92.07 mg/kg. The upper simultaneous limit is 168.8 mg/kg. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 82.63, 100.8, and 202.7 mg/kg, respectively.

Cyanide. The cyanide WBM-S data set includes 76 observations with 69 (90.8%) non-detected results. The 7 detected results range from 0.574 to 1.14 mg/kg. The modified MDL of the 69 non-detected results range from 0.0222 to 0.622 mg/kg. See Figure E-27 for general statistics and a time series plot of the available data.

The overall mean of the cyanide WBM-S data set concentrations using the Kaplan Meier method is 0.127 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the cyanide WBM-S data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.196 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.538 mg/kg is also suggested by ProUCL. The upper prediction limit for the cyanide WBM-S data set at the 95% confidence level is 0.566 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.642 mg/kg. The upper simultaneous limit is 0.942 mg/kg.

Lead. The lead WWBM-S data set includes 77 observations with 0 (0%) non-detected results. The 77 detected results range from 2.28 to 490 mg/kg. See Figure E-28 for general statistics and a time series plot of the available data.

The overall mean of the lead WBM-S data set concentrations using the Kaplan Meier method is 101.2 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the lead WBM-S data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 126.2 mg/kg. The upper prediction limit for the lead WBM-S data set at the 95% confidence level is 323 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 396.2 mg/kg. The upper simultaneous limit is 792.6 mg/kg. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 349.6, 442, and 994.9 mg/kg, respectively.

Mercury. The mercury WBM-S data set includes 77 observations with 1 (1.3%) non-detected result. The 76 detected results range from 0.000895 to 0.624 mg/kg. The modified MDL of the 1 non-detected result is 0.000473 mg/kg. See Figure E-29 for general statistics and a time series plot of the available data.

The overall mean of the mercury WBM-S data set concentrations using the Kaplan Meier method is 0.158 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the mercury WBM-S data set follow

a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.187 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.226 mg/kg is also suggested by ProUCL. The upper prediction limit for the mercury WBM-S data set at the 95% confidence level is 0.498 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.609 mg/kg. The upper simultaneous limit is 1.205 mg/kg. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 0.549, 0.692, and 1.547 mg/kg, respectively.

Nickel. The nickel WBM-S data set includes 77 observations with 3 (3.9%) non-detected results. The 74 detected results range from 0.202 to 12.5 mg/kg. The modified MDL of the 3 non-detected results range from 0.0859 to 0.996 mg/kg. See Figure E-30 for general statistics and a time series plot of the available data.

The overall mean of the nickel WBM-S data set concentrations using the Kaplan Meier method is 4.767 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the nickel WBM-S data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 5.245 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 5.246 mg/kg is also suggested by ProUCL. The upper prediction limit for the nickel WBM-S data set at the 95% confidence level is 8.963 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 9.693 mg/kg. The upper simultaneous limit is 12.57 mg/kg.

Selenium. The selenium WBM-S data set includes 77 observations with 34 (44.2%) non-detected results. The 43 detected results range from 0.198 to 1.74 mg/kg. The modified MDL of the 34 non-detected results range from 0.158 to 1.99 mg/kg. See Figure E-31 for general statistics and a time series plot of the available data.

The overall mean of the selenium WBM-S data set concentrations using the Kaplan Meier method is 0.395 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the selenium WBM-S data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.454 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.455 mg/kg is also suggested by ProUCL. The upper prediction limit for the selenium WBM-S data set at the 95% confidence level is 0.885 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.97 mg/kg. The upper simultaneous limit is 1.306 mg/kg.

Silver. The silver WBM-S data set includes 77 observations with 35 (45.5%) non-detected results. The 42 detected results range from 0.0967 to 3 mg/kg. The modified MDL of the 35 non-detected results range from 0.0717 to 0.885 mg/kg. See Figure E-32 for general statistics and a time series plot of the available data.

The overall mean of the silver WBM-S data set concentrations using the Kaplan Meier method is 0.231 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the silver WBM-S data set follow a lognormal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.299 mg/kg. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.305 mg/kg is also suggested by ProUCL. The upper prediction limit for the silver WBM-S data set at the 95% confidence level is 0.574 mg/kg. The upper 95%

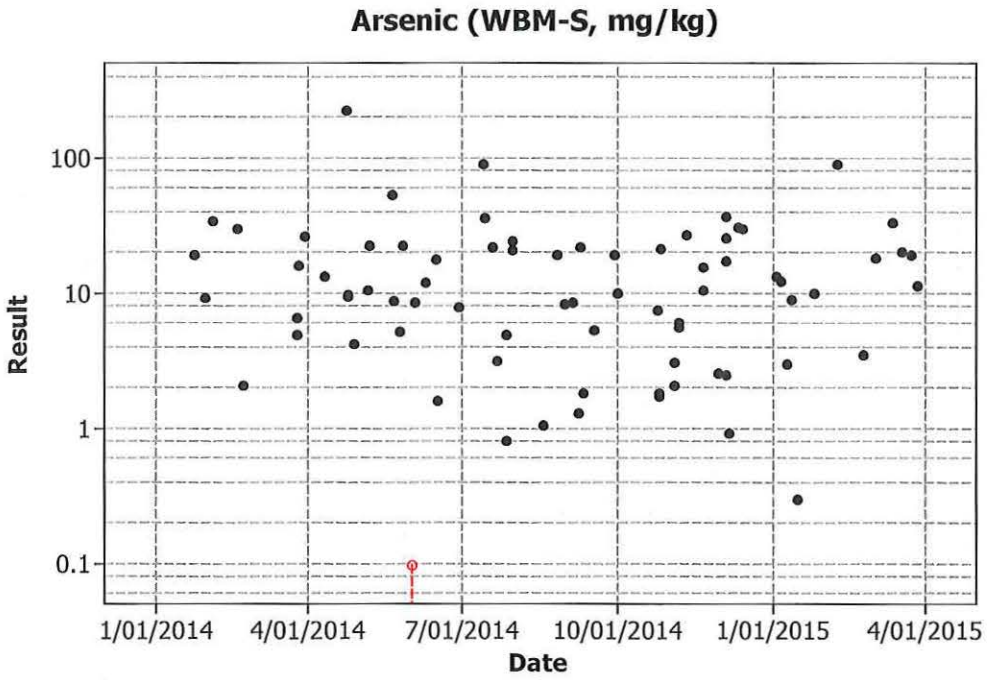
confidence limit on the 95th percentile, or the upper tolerance limit, is 0.721 mg/kg. The upper simultaneous limit is 1.775 mg/kg.

Zinc. The zinc WBM-S data set includes 77 observations with 0 (0%) non-detected results. The 77 detected results range from 1.56 to 218 mg/kg. See Figure E-33 for general statistics and a time series plot of the available data.

The overall mean of the zinc WBM-S data set concentrations using the Kaplan Meier method is 59.48 mg/kg. Goodness of fit tests implemented using ProUCL indicated that the zinc WBM-S data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 69.62 mg/kg. The upper prediction limit for the zinc WBM-S data set at the 95% confidence level is 153.3 mg/kg. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 180.5 mg/kg. The upper simultaneous limit is 318.9 mg/kg. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 158.7, 190, and 360.3 mg/kg, respectively.

Figure E-23. Arsenic (WBM-S, mg/kg) General Statistics and Time Series

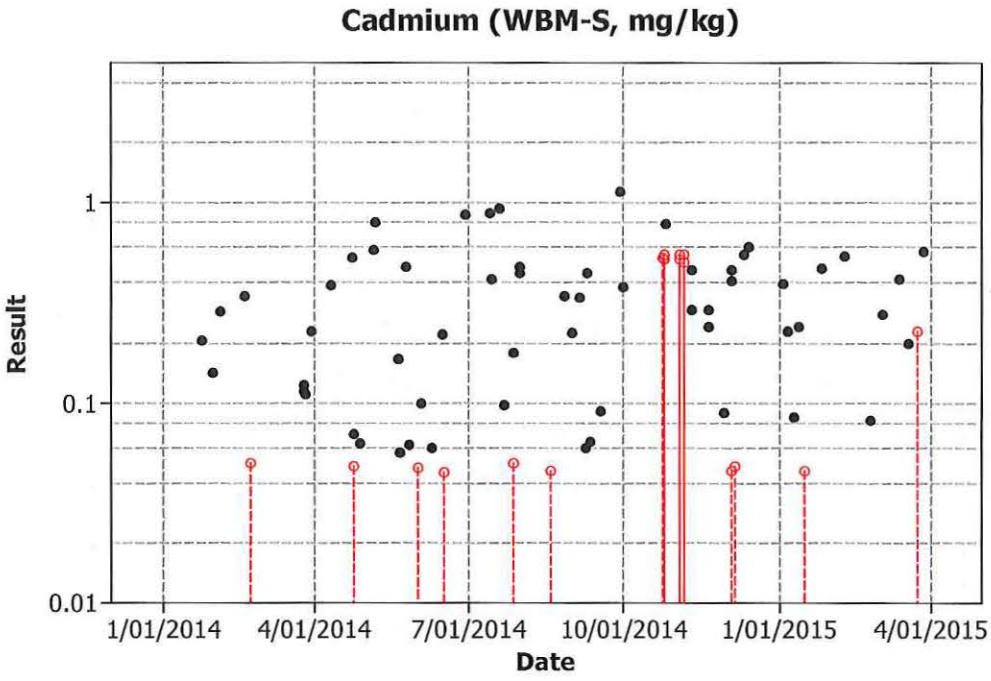
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Arsenic)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	73
Number of Detects (#)	76	Number of Non-Detects (#)	1
Number of Distinct Detects (#)	72	Number of Distinct Non-Detects (#)	1
Minimum Detect (mg/kg)	0.295	Minimum Non-Detect (mg/kg)	0.0954
Maximum Detect (mg/kg)	225	Maximum Non-Detect (mg/kg)	0.0954
Variance Detects $(mg/kg)^2$	839	Percent Non-Detects (%)	1.30%
Mean Detects (mg/kg)	18.22	SD Detects (mg/kg)	28.97
Median Detects (mg/kg)	10.3	CV Detects	1.59
Skewness Detects (mg/kg)	5.352	Kurtosis Detects	35.46
Mean of Logged Detects (log[mg/kg])	2.258	SD of Logged Detects (log[mg/kg])	1.197

Figure E-24. Cadmium (WBM-S, mg/kg) General Statistics and Time Series

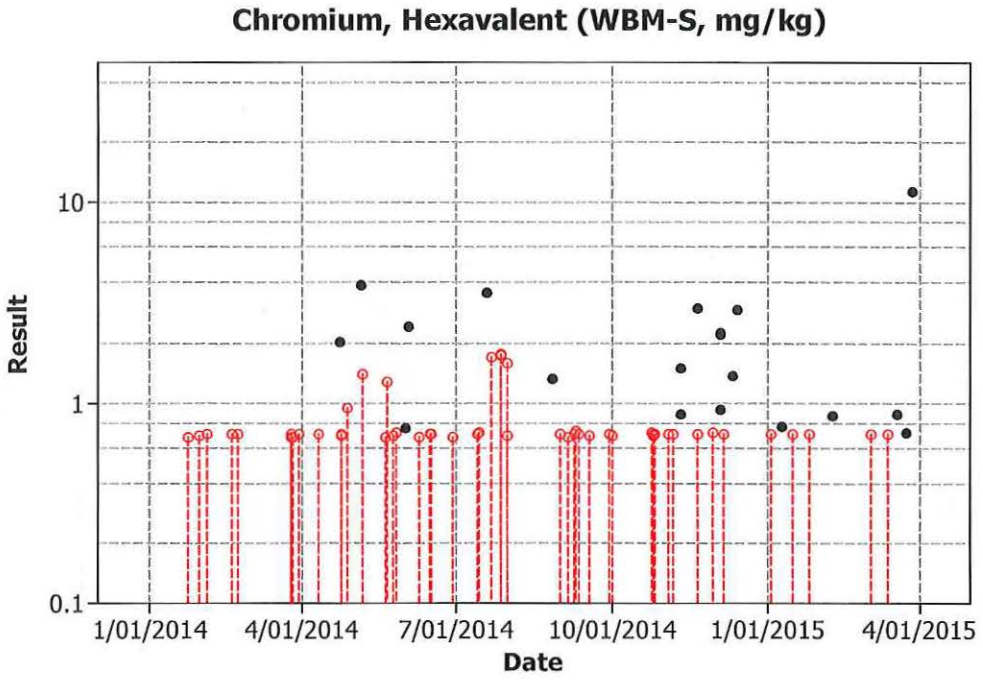
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Cadmium)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	72
Number of Detects (#)	60	Number of Non-Detects (#)	17
Number of Distinct Detects (#)	59	Number of Distinct Non-Detects (#)	15
Minimum Detect (mg/kg)	0.0566	Minimum Non-Detect (mg/kg)	0.0452
Maximum Detect (mg/kg)	1.13	Maximum Non-Detect (mg/kg)	0.553
Variance Detects $(mg/kg)^2$	0.0621	Percent Non-Detects (%)	22.08%
Mean Detects (mg/kg)	0.342	SD Detects (mg/kg)	0.249
Median Detects (mg/kg)	0.291	CV Detects	0.728
Skewness Detects (mg/kg)	1.057	Kurtosis Detects	0.946
Mean of Logged Detects (log[mg/kg])	-1.369	SD of Logged Detects (log[mg/kg])	0.831

Figure E-25. Chromium, hexavalent (WBM-S, mg/kg) General Statistics and Time Series

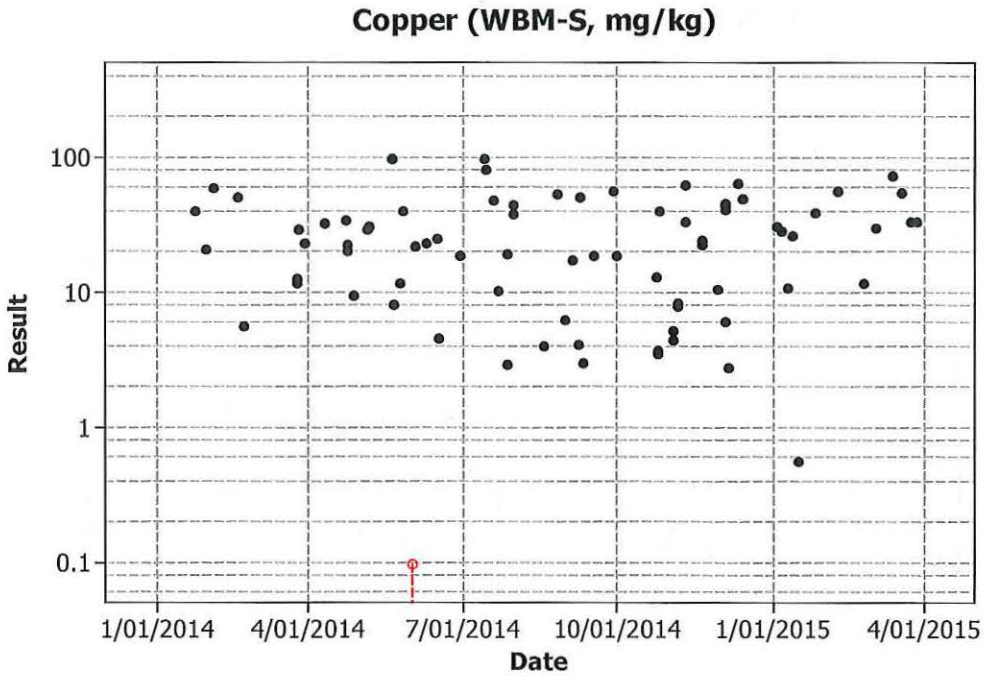
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Chromium, Hexavalent)			
Total Number of Observations (#)	72	Number of Distinct Observations (#)	53
Number of Detects (#)	19	Number of Non-Detects (#)	53
Number of Distinct Detects (#)	18	Number of Distinct Non-Detects (#)	35
Minimum Detect (mg/kg)	0.714	Minimum Non-Detect (mg/kg)	0.67
Maximum Detect (mg/kg)	11.4	Maximum Non-Detect (mg/kg)	1.76
Variance Detects (mg/kg)^2	5.867	Percent Non-Detects (%)	73.61%
Mean Detects (mg/kg)	2.287	SD Detects (mg/kg)	2.422
Median Detects (mg/kg)	1.48	CV Detects	1.059
Skewness Detects (mg/kg)	3.229	Kurtosis Detects	12.08
Mean of Logged Detects (log[mg/kg])	0.523	SD of Logged Detects (log[mg/kg])	0.733

Figure E-26. Copper (WBM-S, mg/kg) General Statistics and Time Series

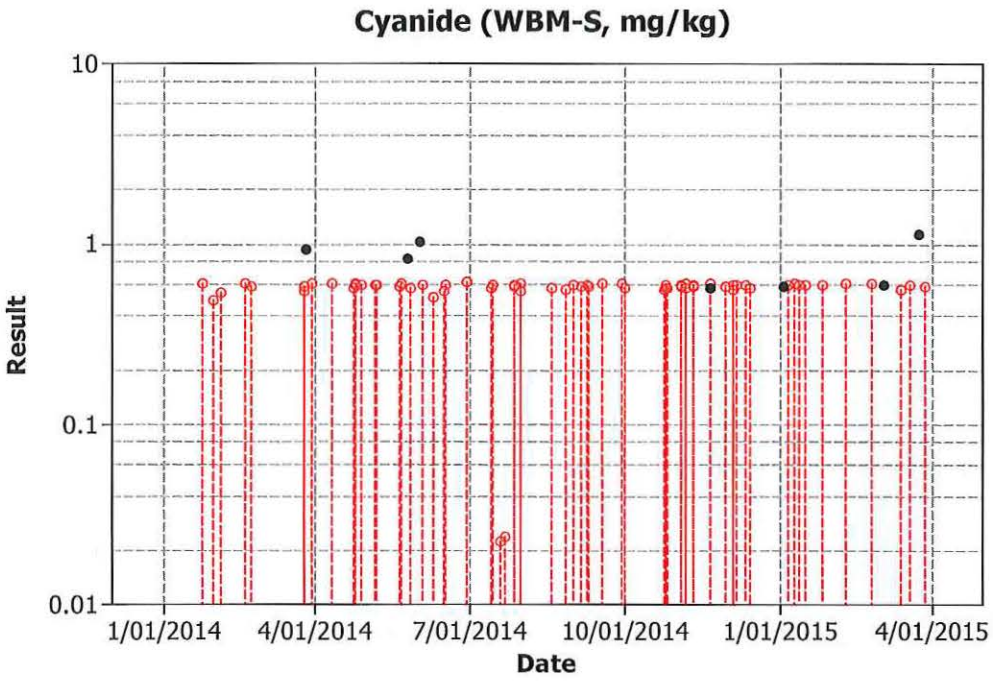
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Copper)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	75
Number of Detects (#)	76	Number of Non-Detects (#)	1
Number of Distinct Detects (#)	74	Number of Distinct Non-Detects (#)	1
Minimum Detect (mg/kg)	0.557	Minimum Non-Detect (mg/kg)	0.0954
Maximum Detect (mg/kg)	97.1	Maximum Non-Detect (mg/kg)	0.0954
Variance Detects (mg/kg)^2	484.3	Percent Non-Detects (%)	1.30%
Mean Detects (mg/kg)	28.29	SD Detects (mg/kg)	22.01
Median Detects (mg/kg)	23.5	CV Detects	0.778
Skewness Detects (mg/kg)	1.064	Kurtosis Detects	1.085
Mean of Logged Detects (log[mg/kg])	2.951	SD of Logged Detects (log[mg/kg])	1.021

Figure E-27. Cyanide (WBM-S, mg/kg) General Statistics and Time Series

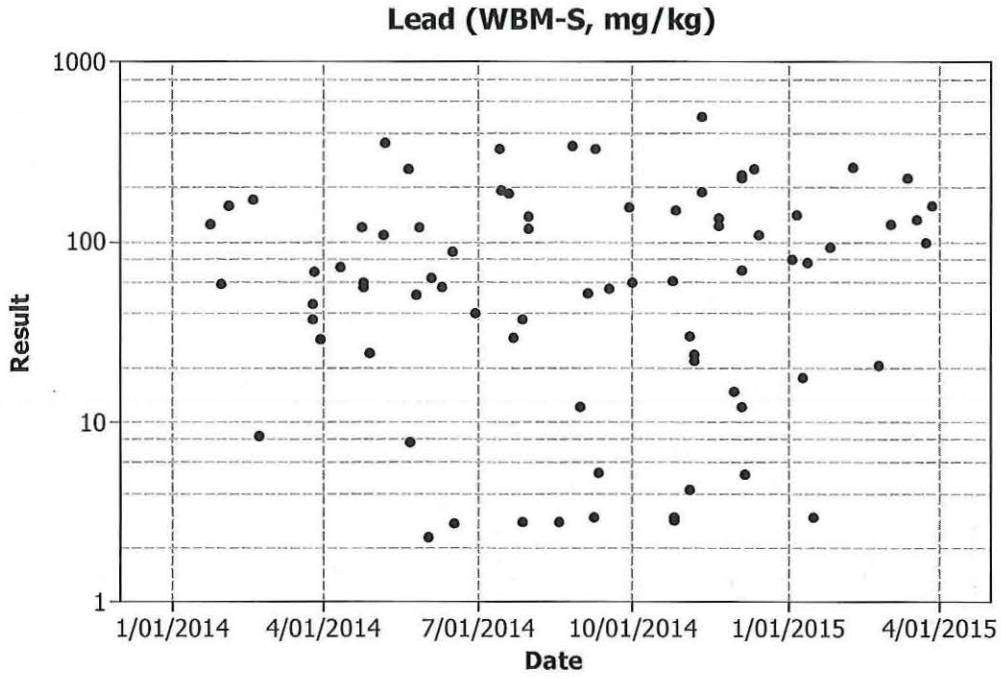
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Cyanide)			
Total Number of Observations (#)	76	Number of Distinct Observations (#)	43
Number of Detects (#)	7	Number of Non-Detects (#)	69
Number of Distinct Detects (#)	7	Number of Distinct Non-Detects (#)	39
Minimum Detect (mg/kg)	0.574	Minimum Non-Detect (mg/kg)	0.0222
Maximum Detect (mg/kg)	1.14	Maximum Non-Detect (mg/kg)	0.622
Variance Detects (mg/kg)^2	0.0549	Percent Non-Detects (%)	90.79%
Mean Detects (mg/kg)	0.809	SD Detects (mg/kg)	0.234
Median Detects (mg/kg)	0.824	CV Detects	0.29
Skewness Detects (mg/kg)	0.23	Kurtosis Detects	-1.877
Mean of Logged Detects (log[mg/kg])	-0.248	SD of Logged Detects (log[mg/kg])	0.293

Figure E-28. Lead (WBM-S, mg/kg) General Statistics and Time Series

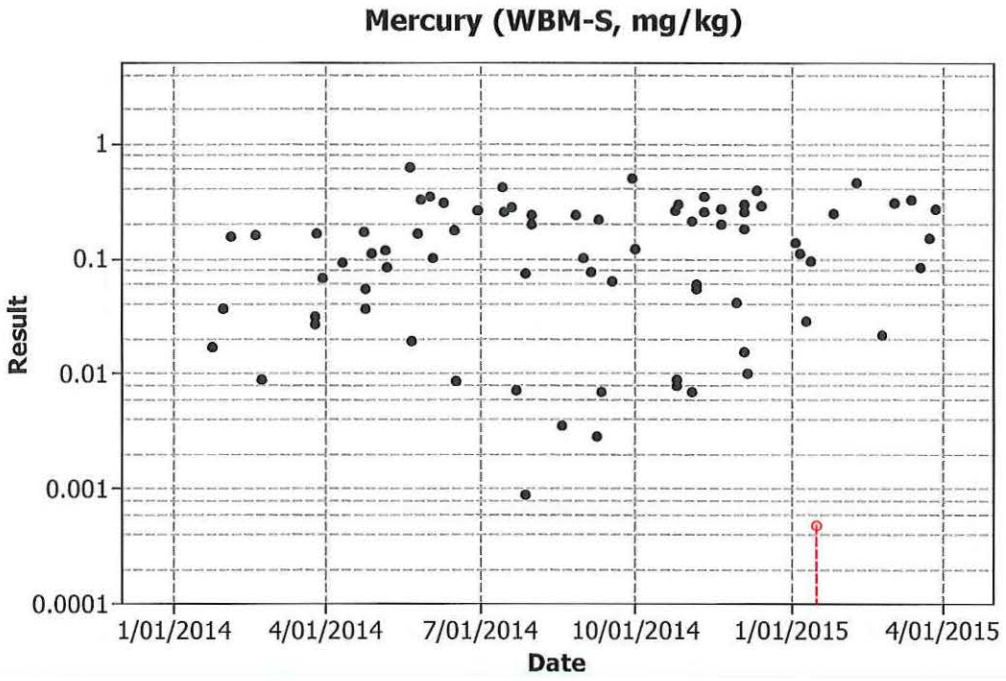
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Lead)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	75
Number of Detects (#)	77	Number of Non-Detects (#)	0
Number of Distinct Detects (#)	75	Number of Distinct Non-Detects (#)	0
Minimum Detect (mg/kg)	2.28	Minimum Non-Detect (mg/kg)	-
Maximum Detect (mg/kg)	490	Maximum Non-Detect (mg/kg)	-
Variance Detects (mg/kg)^2	10140.49	Percent Non-Detects (%)	0.00%
Mean Detects (mg/kg)	101.2	SD Detects (mg/kg)	100.7
Median Detects (mg/kg)	67.8	CV Detects	0.995
Skewness Detects (mg/kg)	1.473	Kurtosis Detects	-
Mean of Logged Detects (log[mg/kg])	3.916	SD of Logged Detects (log[mg/kg])	1.448

Figure E-29. Mercury (WBM-S, mg/kg) General Statistics and Time Series

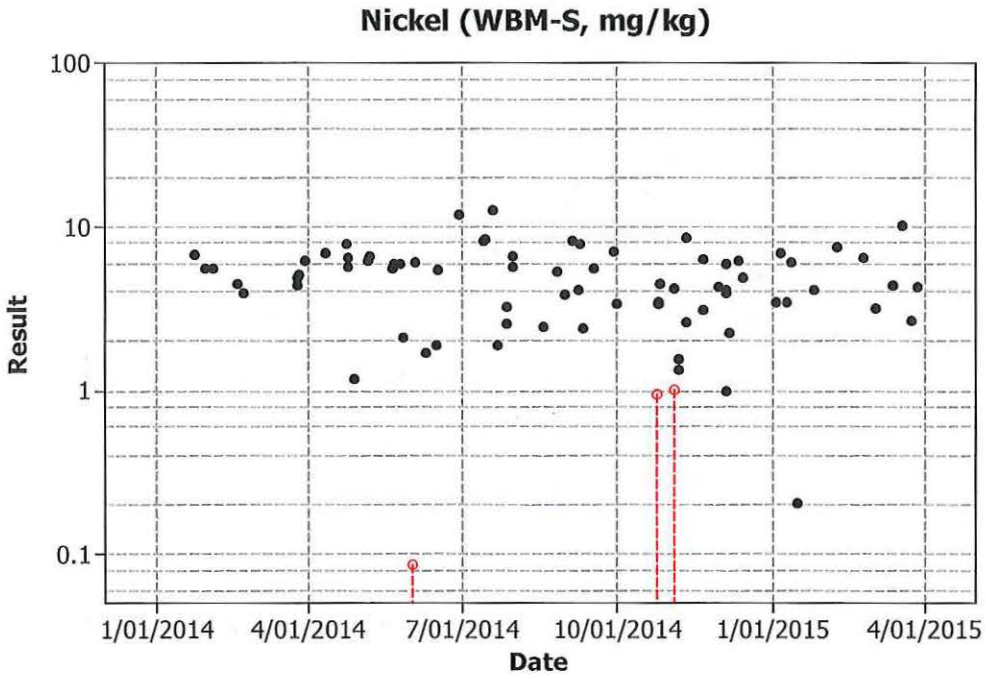
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Mercury)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	75
Number of Detects (#)	76	Number of Non-Detects (#)	1
Number of Distinct Detects (#)	74	Number of Distinct Non-Detects (#)	1
Minimum Detect (mg/kg)	8.95E-04	Minimum Non-Detect (mg/kg)	4.73E-04
Maximum Detect (mg/kg)	0.624	Maximum Non-Detect (mg/kg)	4.73E-04
Variance Detects $(mg/kg)^2$	0.0189	Percent Non-Detects (%)	1.30%
Mean Detects (mg/kg)	0.16	SD Detects (mg/kg)	0.137
Median Detects (mg/kg)	0.13	CV Detects	0.86
Skewness Detects (mg/kg)	0.913	Kurtosis Detects	0.647
Mean of Logged Detects (log[mg/kg])	-2.47	SD of Logged Detects (log[mg/kg])	1.431

Figure E-30. Nickel (WBM-S, mg/kg) General Statistics and Time Series

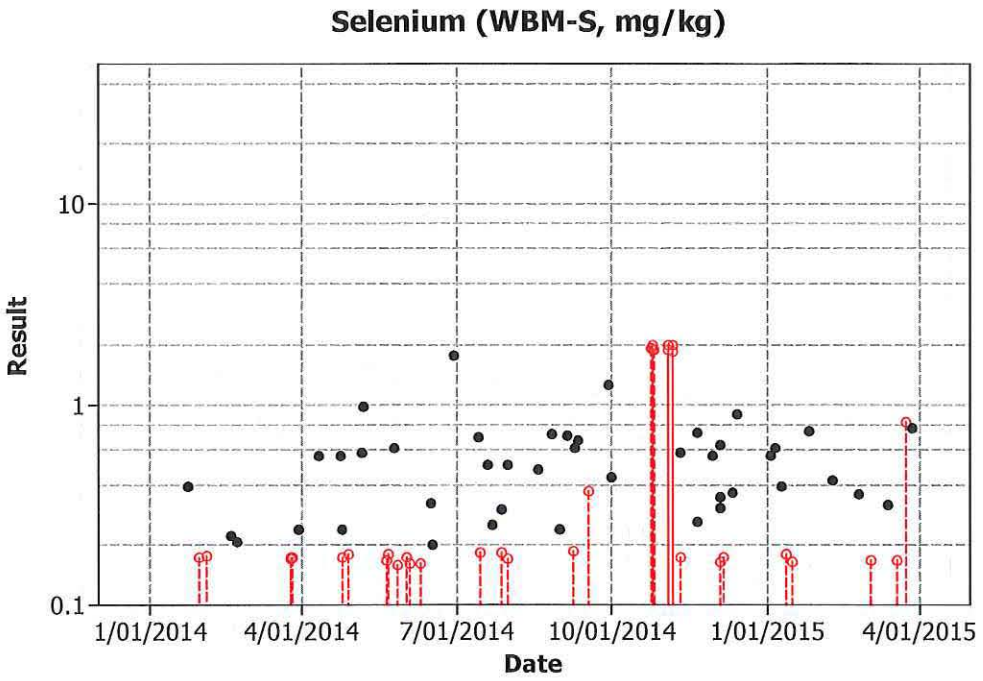
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Nickel)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	73
Number of Detects (#)	74	Number of Non-Detects (#)	3
Number of Distinct Detects (#)	70	Number of Distinct Non-Detects (#)	3
Minimum Detect (mg/kg)	0.202	Minimum Non-Detect (mg/kg)	0.0859
Maximum Detect (mg/kg)	12.5	Maximum Non-Detect (mg/kg)	0.996
Variance Detects (mg/kg)^2	5.717	Percent Non-Detects (%)	3.90%
Mean Detects (mg/kg)	4.952	SD Detects (mg/kg)	2.391
Median Detects (mg/kg)	4.9	CV Detects	0.483
Skewness Detects (mg/kg)	0.613	Kurtosis Detects	0.868
Mean of Logged Detects (log[mg/kg])	1.449	SD of Logged Detects (log[mg/kg])	0.637

Figure E-31. Selenium (WBM-S, mg/kg) General Statistics and Time Series

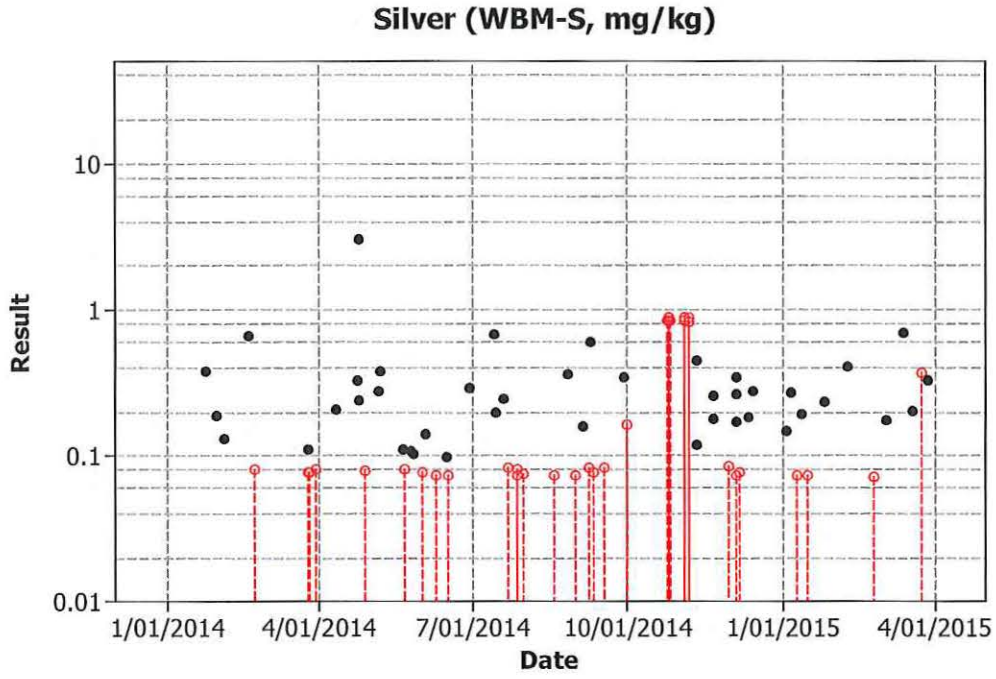
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Selenium)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	64
Number of Detects (#)	43	Number of Non-Detects (#)	34
Number of Distinct Detects (#)	39	Number of Distinct Non-Detects (#)	25
Minimum Detect (mg/kg)	0.198	Minimum Non-Detect (mg/kg)	0.158
Maximum Detect (mg/kg)	1.74	Maximum Non-Detect (mg/kg)	1.99
Variance Detects (mg/kg)^2	0.0871	Percent Non-Detects (%)	44.16%
Mean Detects (mg/kg)	0.532	SD Detects (mg/kg)	0.295
Median Detects (mg/kg)	0.503	CV Detects	0.555
Skewness Detects (mg/kg)	1.962	Kurtosis Detects	5.972
Mean of Logged Detects (log[mg/kg])	-0.756	SD of Logged Detects (log[mg/kg])	0.5

Figure E-32. Silver (WBM-S, mg/kg) General Statistics and Time Series

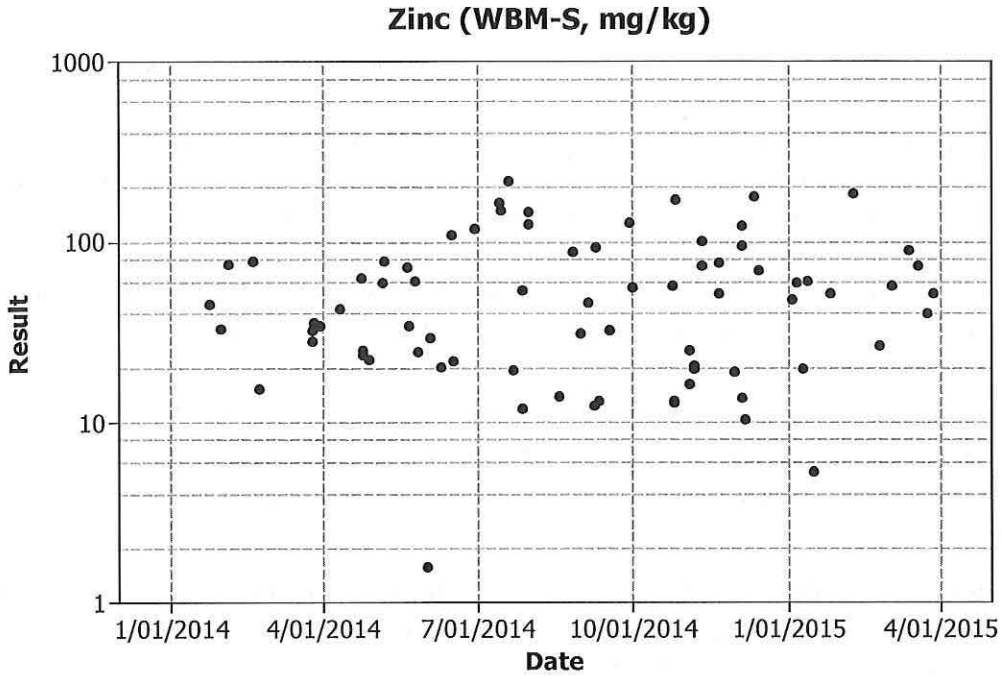
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Silver)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	70
Number of Detects (#)	42	Number of Non-Detects (#)	35
Number of Distinct Detects (#)	40	Number of Distinct Non-Detects (#)	30
Minimum Detect (mg/kg)	0.0967	Minimum Non-Detect (mg/kg)	0.0717
Maximum Detect (mg/kg)	3	Maximum Non-Detect (mg/kg)	0.885
Variance Detects (mg/kg)^2	0.201	Percent Non-Detects (%)	45.45%
Mean Detects (mg/kg)	0.337	SD Detects (mg/kg)	0.449
Median Detects (mg/kg)	0.24	CV Detects	1.33
Skewness Detects (mg/kg)	5.355	Kurtosis Detects	31.87
Mean of Logged Detects (log[mg/kg])	-1.383	SD of Logged Detects (log[mg/kg])	0.658

Figure E-33. Zinc (WBM-S, mg/kg) General Statistics and Time Series

(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Zinc)			
Total Number of Observations (#)	77	Number of Distinct Observations (#)	76
Number of Detects (#)	77	Number of Non-Detects (#)	0
Number of Distinct Detects (#)	76	Number of Distinct Non-Detects (#)	0
Minimum Detect (mg/kg)	1.56	Minimum Non-Detect (mg/kg)	-
Maximum Detect (mg/kg)	218	Maximum Non-Detect (mg/kg)	-
Variance Detects (mg/kg)^2	2304.9601	Percent Non-Detects (%)	0%
Mean Detects (mg/kg)	59.48	SD Detects (mg/kg)	48.01
Median Detects (mg/kg)	47.5	CV Detects	0.807
Skewness Detects (mg/kg)	1.304	Kurtosis Detects	-
Mean of Logged Detects (log[mg/kg])	3.743	SD of Logged Detects (log[mg/kg])	0.904

E-5.3 Water Based Muds–Aqueous

Arsenic. The arsenic WBM-A data set includes 24 observations with 3 (12.5%) non-detected results. The 21 detected results range from 0.0032 to 0.828 mg/L. The modified MDL of the 3 non-detected results range from 0.001 to 0.2 mg/L. See Figure E-34 for general statistics and a time series plot of the available data.

The overall mean of the arsenic WBM-A data set concentrations using the Kaplan Meier method is 0.149 mg/L. Goodness of fit tests implemented using ProUCL indicated that the arsenic WBM-A data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.28 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.352 mg/L is also suggested by ProUCL. The upper prediction limit for the arsenic WBM-A data set at the 95% confidence level is 0.546 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.844 mg/L. The upper simultaneous limit is 1.065 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 0.574, 0.948, and 1.244 mg/L, respectively.

Cadmium. The cadmium WBM-A data set includes 24 observations with 16 (66.7%) non-detected results. The 8 detected results range from 0.000929 to 0.282 mg/L. The modified MDL of the 16 non-detected results range from 0.0008 to 0.16 mg/L. See Figure E-35 for general statistics and a time series plot of the available data.

The overall mean of the cadmium WBM-A data set concentrations using the Kaplan Meier method is 0.0333 mg/L. Goodness of fit tests implemented using ProUCL indicated that the cadmium WBM-A data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.0619 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.0619 mg/L is also suggested by ProUCL. The upper prediction limit for the cadmium WBM-A data set at the 95% confidence level is 0.167 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.209 mg/L. The upper simultaneous limit is 0.235 mg/L.

Chromium, Hexavalent. The hexavalent chromium WBM-A data set includes 24 observations with 16 (66.7%) non-detected results. The 8 detected results range from 0.004 to 0.019 mg/L. The modified MDL of the 16 non-detected results range from 0.004 to 0.2 mg/L. See Figure E-36 for general statistics and a time series plot of the available data.

The overall mean of the hexavalent chromium WBM-A data set concentrations using the Kaplan Meier method is 0.00563 mg/L. Goodness of fit tests implemented using ProUCL indicated that the hexavalent chromium WBM-A data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.00705 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.00703 mg/L is also suggested by ProUCL. The upper prediction limit for the hexavalent chromium WBM-A data set at the 95% confidence level is 0.0118 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.0138 mg/L. The upper simultaneous limit is 0.015 mg/L.

Copper. The copper WBM-A data set includes 23 observations with 8 (34.8%) non-detected results. The 15 detected results range from 0.00309 to 2.5 mg/L. The modified MDL of the 8 non-detected results

range from 0.001 to 0.05 mg/L. See Figure E-37 general statistics and for a time series plot of the available data.

The overall mean of the copper WBM-A data set concentrations using the Kaplan Meier method is 0.366 mg/L. Goodness of fit tests implemented using ProUCL indicated that the copper WBM-A data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.847 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.619 mg/L is also suggested by ProUCL. The upper prediction limit for the copper WBM-A data set at the 95% confidence level is 1.504 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 2.569 mg/L. The upper simultaneous limit is 3.274 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 1.616, 3.079, and 4.139 mg/L, respectively.

Cyanide, Dissolved. The dissolved cyanide WBM-A data set includes 21 observations with 18 (85.7%) non-detected results. The 3 detected results range from 0.0552 to 0.499 mg/L. The modified MDL of the 18 non-detected results range from 0.02 to 1 mg/L. See Figure E-38 for general statistics and a time series plot of the available data.

The overall mean of the dissolved cyanide WBM-A data set concentrations using the Kaplan Meier method is 0.0483 mg/L. Goodness of fit tests implemented using ProUCL indicated that the dissolved cyanide WBM-A data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.0975 mg/L. The upper prediction limit for the dissolved cyanide WBM-A data set at the 95% confidence level is 0.232 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.295 mg/L. The upper simultaneous limit is 0.317 mg/L.

Lead. The lead WBM-A data set includes 24 observations with 10 (41.7%) non-detected results. The 14 detected results range from 0.0474 to 33.4 mg/L. The modified MDL of the 10 non-detected results range from 0.0007 to 0.035 mg/L. See Figure E-39 for general statistics and a time series plot of the available data.

The overall mean of the lead WBM-A data set concentrations using the Kaplan Meier method is 3.175 mg/L. Goodness of fit tests implemented using ProUCL indicated that the lead WBM-A data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 10.26 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 5.936 mg/L is also suggested by ProUCL. The upper prediction limit for the lead WBM-A data set at the 95% confidence level is 11.77 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 21.19 mg/L. The upper simultaneous limit is 28.71 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 11.77, 24.29, and 35.44 mg/L, respectively.

Mercury. The mercury WBM-A data set includes 23 observations with 8 (34.8%) non-detected results. The 15 detected results range from 0.000072 to 0.0255 mg/L. The modified MDL of the 8 non-detected results range from 0.000042 to 0.000042 mg/L. See Figure E-34 for general statistics and a time series plot of the available data.

The overall mean of the mercury WBM-A data set concentrations using the Kaplan Meier method is 0.00303 mg/L. Goodness of fit tests implemented using ProUCL indicated that the mercury WBM-A data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.00704 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.00541 mg/L is also suggested by ProUCL. The upper prediction limit for the mercury WBM-A data set at the 95% confidence level is 0.0121 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.0201 mg/L. The upper simultaneous limit is 0.0253 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 0.0128, 0.0234, and 0.0308 mg/L, respectively.

Nickel. The nickel WBM-A data set includes 24 observations with 11 (45.8%) non-detected results. The 13 detected results range from 0.007 to 0.461 mg/L. The modified MDL of the 11 non-detected results range from 0.005 to 0.2 mg/L. See Figure E-41 for general statistics and a time series plot of the available data.

The overall mean of the nickel WBM-A data set concentrations using the Kaplan Meier method is 0.0547 mg/L. Goodness of fit tests implemented using ProUCL indicated that the nickel WBM-A data set follow a lognormal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.15 mg/L. The upper prediction limit for the nickel WBM-A data set at the 95% confidence level is 0.199 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.418 mg/L. The upper simultaneous limit is 0.653 mg/L.

Selenium. The selenium WBM-A data set includes 24 observations with 15 (62.5%) non-detected results. The 9 detected results range from 0.00717 to 0.0596 mg/L. The modified MDL of the 15 non-detected results range from 0.001 to 0.2 mg/L. See Figure E-42 for general statistics and a time series plot of the available data.

The overall mean of the selenium WBM-A data set concentrations using the Kaplan Meier method is 0.0145 mg/L. Goodness of fit tests implemented using ProUCL indicated that the selenium WBM-A data set follow a normal distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 0.0219 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 0.0213 mg/L is also suggested by ProUCL. The upper prediction limit for the selenium WBM-A data set at the 95% confidence level is 0.0452 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 0.055 mg/L. The upper simultaneous limit is 0.0609 mg/L.

Silver. The silver WBM-A data set includes 24 observations with 22 (91.7%) non-detected results. The 2 detected results range from 0.0393 to 0.133 mg/L. The modified MDL of the 22 non-detected results range from 0.0008 to 0.16 mg/L. See Figure E-43 for general statistics and a time series plot of the available data.

The overall mean of the silver WBM-A data set concentrations using the Kaplan Meier method is 0.00859 mg/L. There are insufficient detected observations to determine the distribution of the data using goodness of fit tests. There are insufficient detected observations to estimate the upper prediction, tolerance or simultaneous limits.

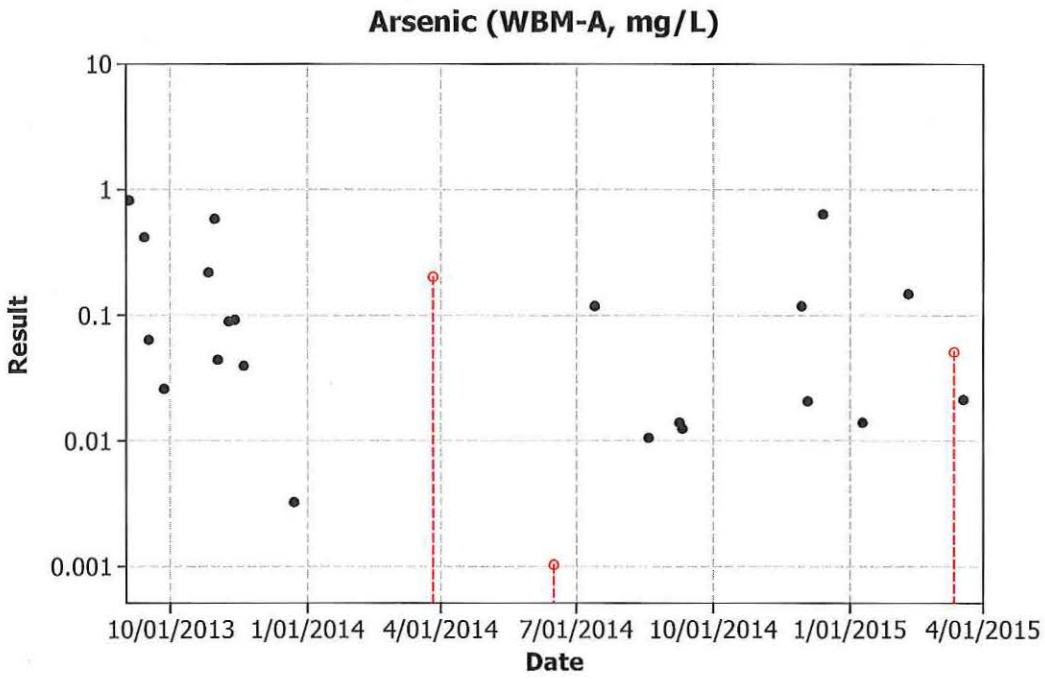
Zinc. The zinc WBM-A data set includes 23 observations with 9 (39.1%) non-detected results. The 14 detected results range from 0.00599 to 40.3 mg/L. The modified MDL of the 9 non-detected results range

from 0.0025 to 0.125 mg/L. See Figure E-44 for general statistics and a time series plot of the available data.

The overall mean of the zinc WBM-A data set concentrations using the Kaplan Meier method is 3.499 mg/L. Goodness of fit tests implemented using ProUCL indicated that the zinc WBM-A data set follow a gamma distribution at the 95% confidence level. Based on this outcome, the upper 95th percentile confidence limit on the mean is estimated using ProUCL as 14.98 mg/L. An alternative estimate for the upper 95th percentile confidence limit on the mean of 7.64 mg/L is also suggested by ProUCL. The upper prediction limit for the zinc WBM-A data set at the 95% confidence level is 11.74 mg/L. The upper 95% confidence limit on the 95th percentile, or the upper tolerance limit, is 21.56 mg/L. The upper simultaneous limit is 28.27 mg/L. Corresponding, alternative Hawkins-Wixley estimates of the upper prediction, tolerance and simultaneous limits are 10.74, 22.38, and 31.17 mg/L, respectively.

Figure E-34. Arsenic (WBM-A, mg/L) General Statistics and Time Series

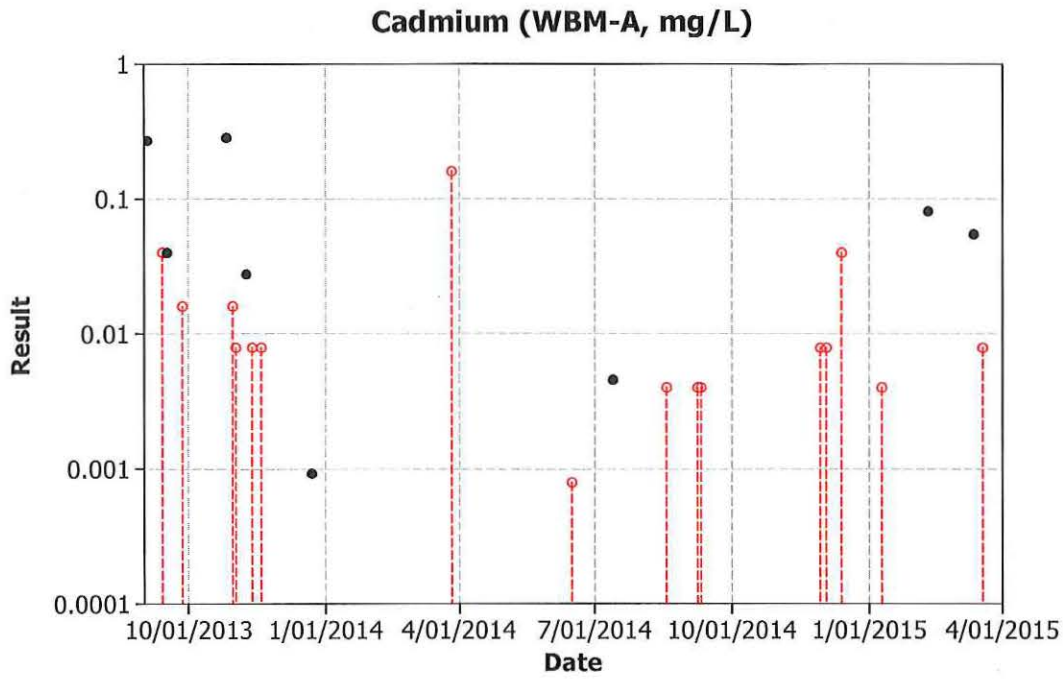
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Arsenic)			
Total Number of Observations (#)	24	Number of Distinct Observations (#)	24
Number of Detects (#)	21	Number of Non-Detects (#)	3
Number of Distinct Detects (#)	21	Number of Distinct Non-Detects (#)	3
Minimum Detect (mg/L)	0.0032	Minimum Non-Detect (mg/L)	0.001
Maximum Detect (mg/L)	0.828	Maximum Non-Detect (mg/L)	0.2
Variance Detects $(mg/L)^2$	0.0568	Percent Non-Detects (%)	12.50%
Mean Detects (mg/L)	0.167	SD Detects (mg/L)	0.238
Median Detects (mg/L)	0.0629	CV Detects	1.427
Skewness Detects	1.807	Kurtosis Detects	2.28
Mean of Logged Detects (log[mg/L])	-2.782	SD of Logged Detects (log[mg/L])	1.529

Figure E-35. Cadmium (WBM-A, mg/L) General Statistics and Time Series

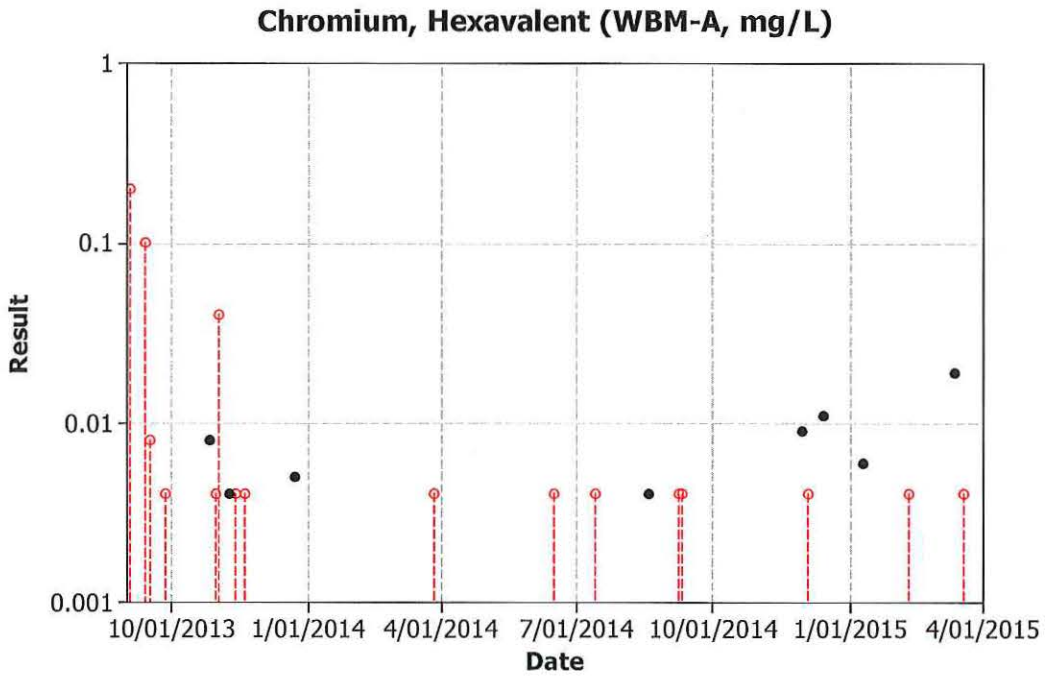
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Cadmium)			
Total Number of Observations (#)	24	Number of Distinct Observations (#)	14
Number of Detects (#)	8	Number of Non-Detects (#)	16
Number of Distinct Detects (#)	8	Number of Distinct Non-Detects (#)	6
Minimum Detect (mg/L)	9.29E-04	Minimum Non-Detect (mg/L)	8.00E-04
Maximum Detect (mg/L)	0.282	Maximum Non-Detect (mg/L)	0.16
Variance Detects $(mg/L)^2$	0.0133	Percent Non-Detects (%)	66.67%
Mean Detects (mg/L)	0.0952	SD Detects (mg/L)	0.115
Median Detects (mg/L)	0.0472	CV Detects	1.209
Skewness Detects	1.237	Kurtosis Detects	-0.267
Mean of Logged Detects (log[mg/L])	-3.398	SD of Logged Detects (log[mg/L])	1.958

Figure E-36. Chromium, hexavalent (WBM-A, mg/L) General Statistics and Time Series

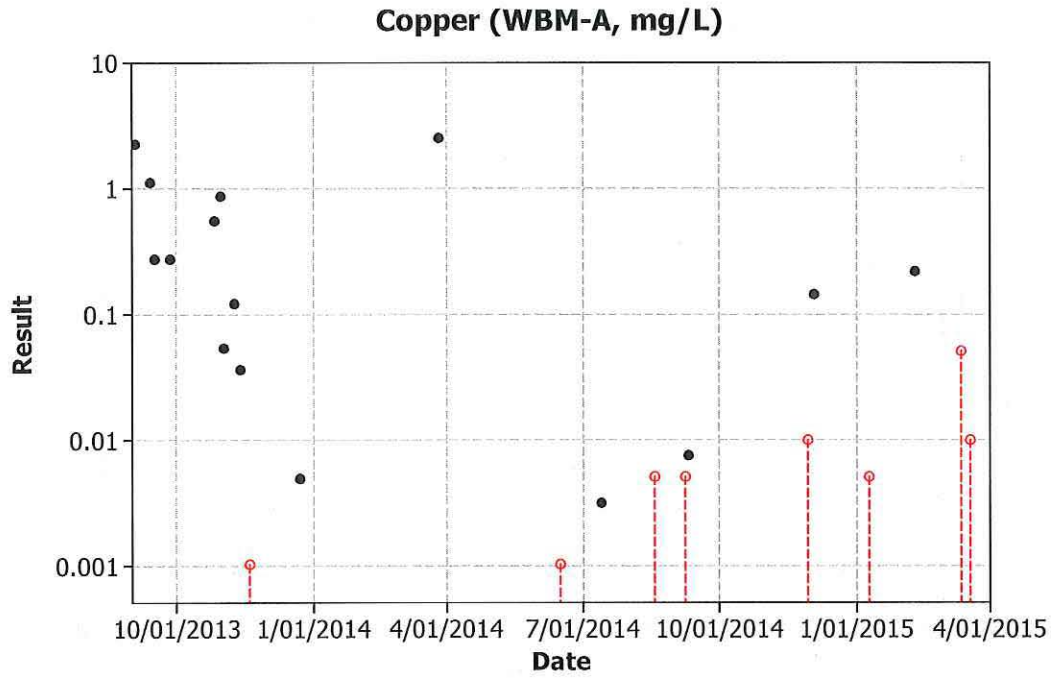
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Chromium, Hexavalent)			
Total Number of Observations (#)	24	Number of Distinct Observations (#)	10
Number of Detects (#)	8	Number of Non-Detects (#)	16
Number of Distinct Detects (#)	7	Number of Distinct Non-Detects (#)	5
Minimum Detect (mg/L)	0.004	Minimum Non-Detect (mg/L)	0.004
Maximum Detect (mg/L)	0.019	Maximum Non-Detect (mg/L)	0.2
Variance Detects $(mg/L)^2$	2.51E-05	Percent Non-Detects (%)	66.67%
Mean Detects (mg/L)	0.00825	SD Detects (mg/L)	0.00501
Median Detects (mg/L)	0.007	CV Detects	0.607
Skewness Detects	1.615	Kurtosis Detects	2.846
Mean of Logged Detects (log[mg/L])	-4.934	SD of Logged Detects (log[mg/L])	0.54

Figure E-37. Copper (WBM-A, mg/L) General Statistics and Time Series

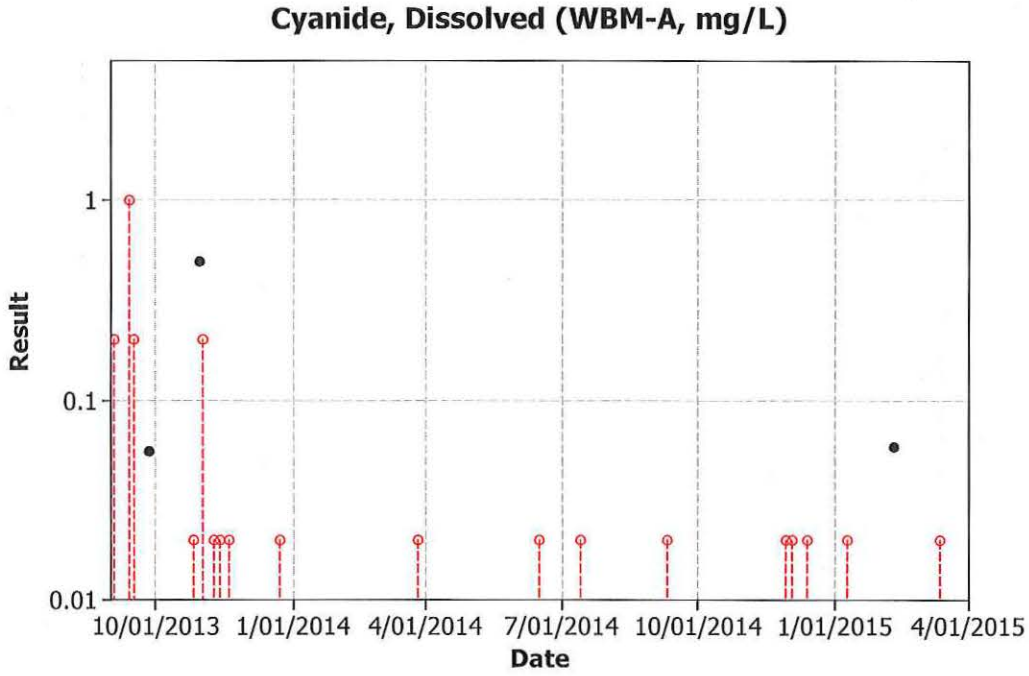
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Copper)			
Total Number of Observations (#)	23	Number of Distinct Observations (#)	18
Number of Detects (#)	15	Number of Non-Detects (#)	8
Number of Distinct Detects (#)	14	Number of Distinct Non-Detects (#)	4
Minimum Detect (mg/L)	0.00309	Minimum Non-Detect (mg/L)	0.001
Maximum Detect (mg/L)	2.5	Maximum Non-Detect (mg/L)	0.05
Variance Detects $(mg/L)^2$	0.644	Percent Non-Detects (%)	34.78%
Mean Detects (mg/L)	0.559	SD Detects (mg/L)	0.803
Median Detects (mg/L)	0.218	CV Detects	1.436
Skewness Detects	1.765	Kurtosis Detects	2.168
Mean of Logged Detects (log[mg/L])	-1.954	SD of Logged Detects (log[mg/L])	2.133

Figure E-38. Cyanide, dissolved (WBM-A, mg/L) General Statistics and Time Series

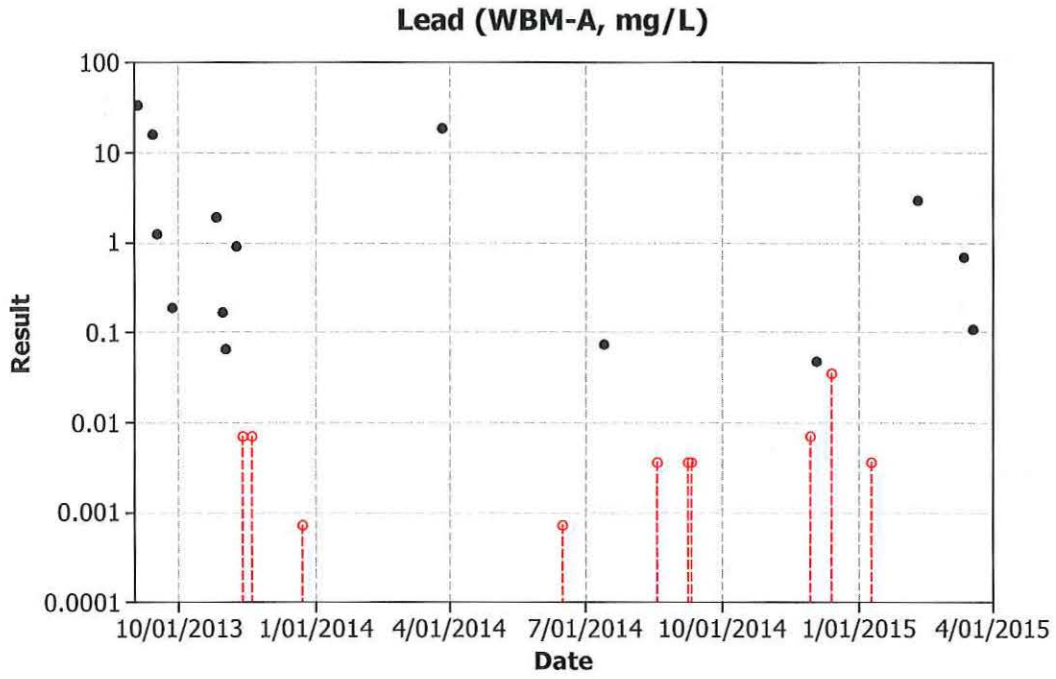
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Cyanide, Dissolved)			
Total Number of Observations (#)	21	Number of Distinct Observations (#)	6
Number of Detects (#)	3	Number of Non-Detects (#)	18
Number of Distinct Detects (#)	3	Number of Distinct Non-Detects (#)	3
Minimum Detect (mg/L)	0.0552	Minimum Non-Detect (mg/L)	0.02
Maximum Detect (mg/L)	0.499	Maximum Non-Detect (mg/L)	1
Variance Detects $(mg/L)^2$	0.0652	Percent Non-Detects (%)	85.71%
Mean Detects (mg/L)	0.204	SD Detects (mg/L)	0.255
Median Detects (mg/L)	0.058	CV Detects	1.252
Skewness Detects	1.732	Kurtosis Detects	N/A
Mean of Logged Detects (log[mg/L])	-2.146	SD of Logged Detects (log[mg/L])	1.257

Figure E-39. Lead (WBM-A, mg/L) General Statistics and Time Series

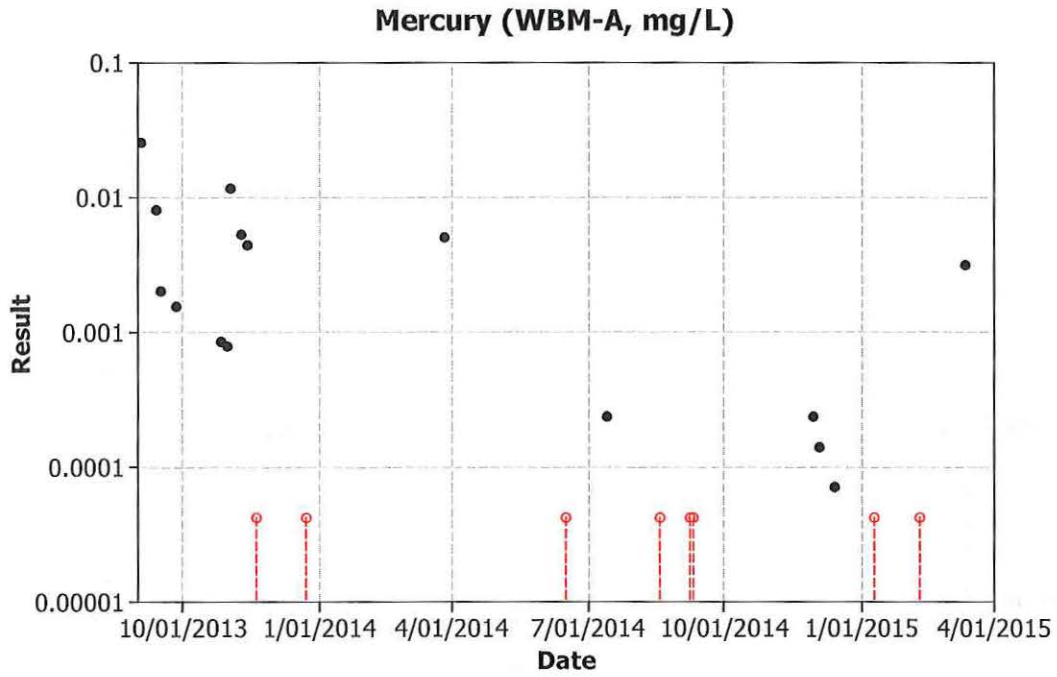
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Lead)			
Total Number of Observations (#)	24	Number of Distinct Observations (#)	18
Number of Detects (#)	14	Number of Non-Detects (#)	10
Number of Distinct Detects (#)	14	Number of Distinct Non-Detects (#)	4
Minimum Detect (mg/L)	0.0474	Minimum Non-Detect (mg/L)	7.00E-04
Maximum Detect (mg/L)	33.4	Maximum Non-Detect (mg/L)	0.035
Variance Detects (mg/L)^2	101.1	Percent Non-Detects (%)	41.67%
Mean Detects (mg/L)	5.442	SD Detects (mg/L)	10.06
Median Detects (mg/L)	0.793	CV Detects	1.848
Skewness Detects	2.12	Kurtosis Detects	4.046
Mean of Logged Detects (log[mg/L])	-0.249	SD of Logged Detects (log[mg/L])	2.221

Figure E-40. Mercury (WBM-A, mg/L) General Statistics and Time Series

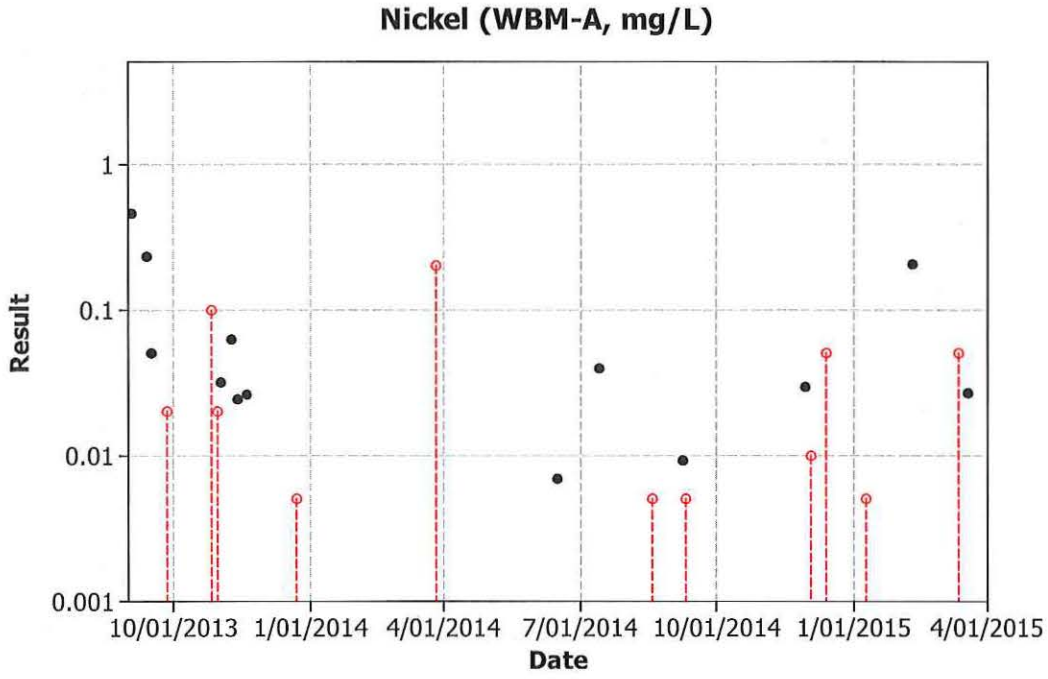
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Mercury)			
Total Number of Observations (#)	23	Number of Distinct Observations (#)	16
Number of Detects (#)	15	Number of Non-Detects (#)	8
Number of Distinct Detects (#)	15	Number of Distinct Non-Detects (#)	1
Minimum Detect (mg/L)	7.20E-05	Minimum Non-Detect (mg/L)	4.20E-05
Maximum Detect (mg/L)	0.0255	Maximum Non-Detect (mg/L)	4.20E-05
Variance Detects $(mg/L)^2$	4.46E-05	Percent Non-Detects (%)	34.78%
Mean Detects (mg/L)	0.00462	SD Detects (mg/L)	0.00668
Median Detects (mg/L)	0.00201	CV Detects	1.445
Skewness Detects	2.481	Kurtosis Detects	6.974
Mean of Logged Detects (log[mg/L])	-6.438	SD of Logged Detects (log[mg/L])	1.739

Figure E-41. Nickel (WBM-A, mg/L) General Statistics and Time Series

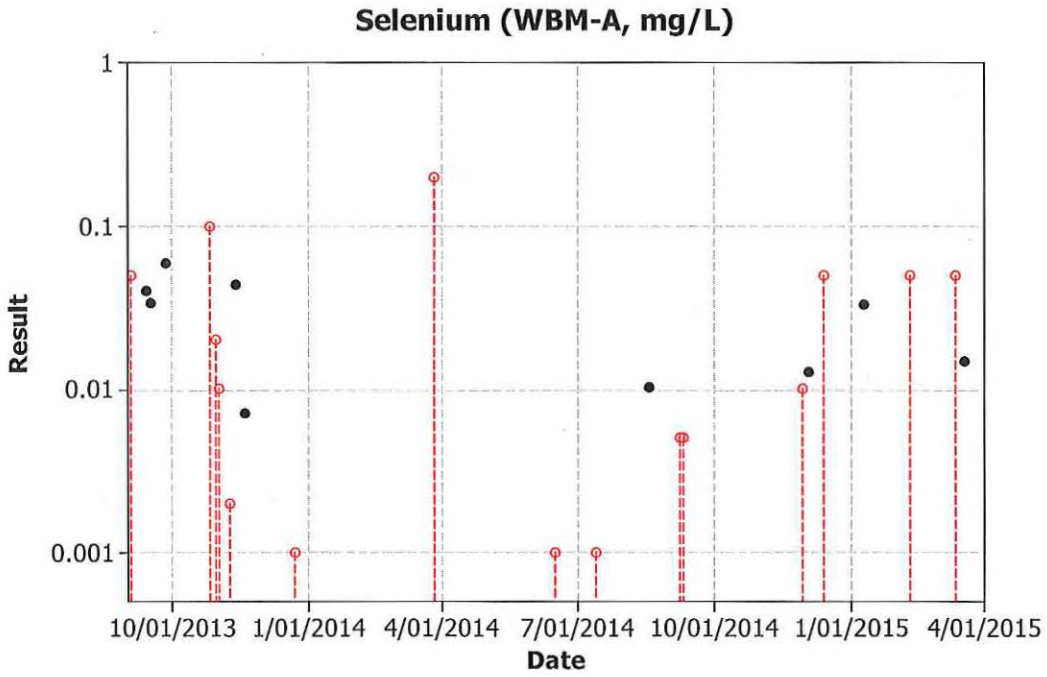
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Nickel)			
Total Number of Observations (#)	24	Number of Distinct Observations (#)	19
Number of Detects (#)	13	Number of Non-Detects (#)	11
Number of Distinct Detects (#)	13	Number of Distinct Non-Detects (#)	6
Minimum Detect (mg/L)	0.007	Minimum Non-Detect (mg/L)	0.005
Maximum Detect (mg/L)	0.461	Maximum Non-Detect (mg/L)	0.2
Variance Detects $(mg/L)^2$	0.0174	Percent Non-Detects (%)	45.83%
Mean Detects (mg/L)	0.0927	SD Detects (mg/L)	0.132
Median Detects (mg/L)	0.0315	CV Detects	1.423
Skewness Detects	2.201	Kurtosis Detects	4.797
Mean of Logged Detects (log[mg/L])	-3.108	SD of Logged Detects (log[mg/L])	1.215

Figure E-42. Selenium (WBM-A, mg/L) General Statistics and Time Series

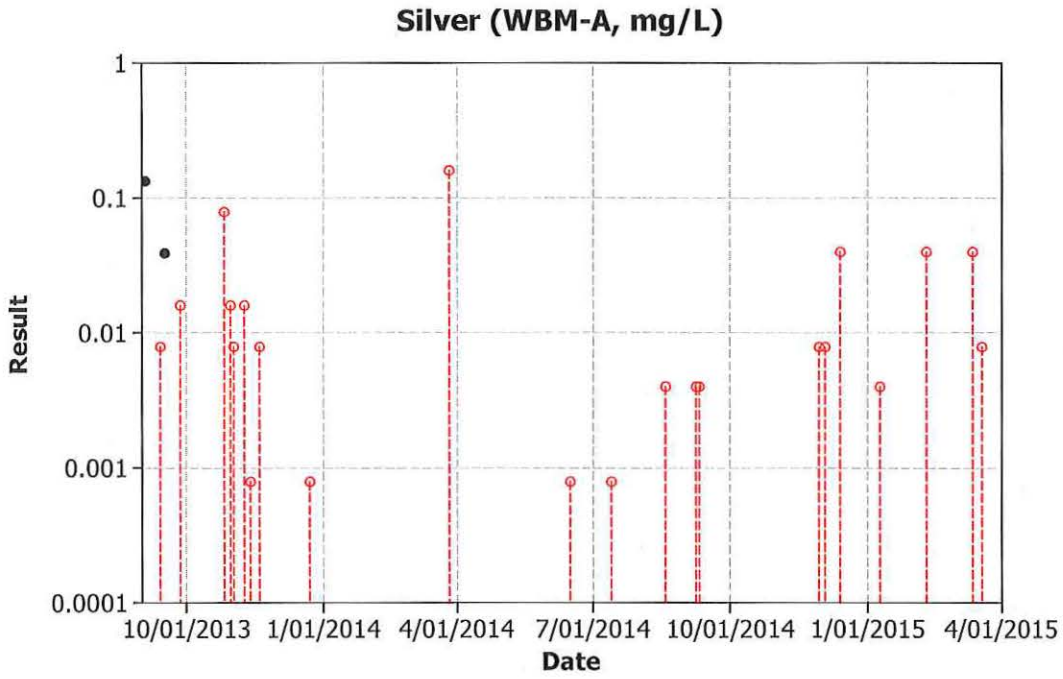
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Selenium)			
Total Number of Observations (#)	24	Number of Distinct Observations (#)	17
Number of Detects (#)	9	Number of Non-Detects (#)	15
Number of Distinct Detects (#)	9	Number of Distinct Non-Detects (#)	8
Minimum Detect (mg/L)	0.00717	Minimum Non-Detect (mg/L)	0.001
Maximum Detect (mg/L)	0.0596	Maximum Non-Detect (mg/L)	0.2
Variance Detects $(mg/L)^2$	3.25E-04	Percent Non-Detects (%)	62.50%
Mean Detects (mg/L)	0.0284	SD Detects (mg/L)	0.018
Median Detects (mg/L)	0.0333	CV Detects	0.636
Skewness Detects	0.391	Kurtosis Detects	-0.956
Mean of Logged Detects (log[mg/L])	-3.784	SD of Logged Detects (log[mg/L])	0.746

Figure E-43. Silver (WBM-A, mg/L) General Statistics and Time Series

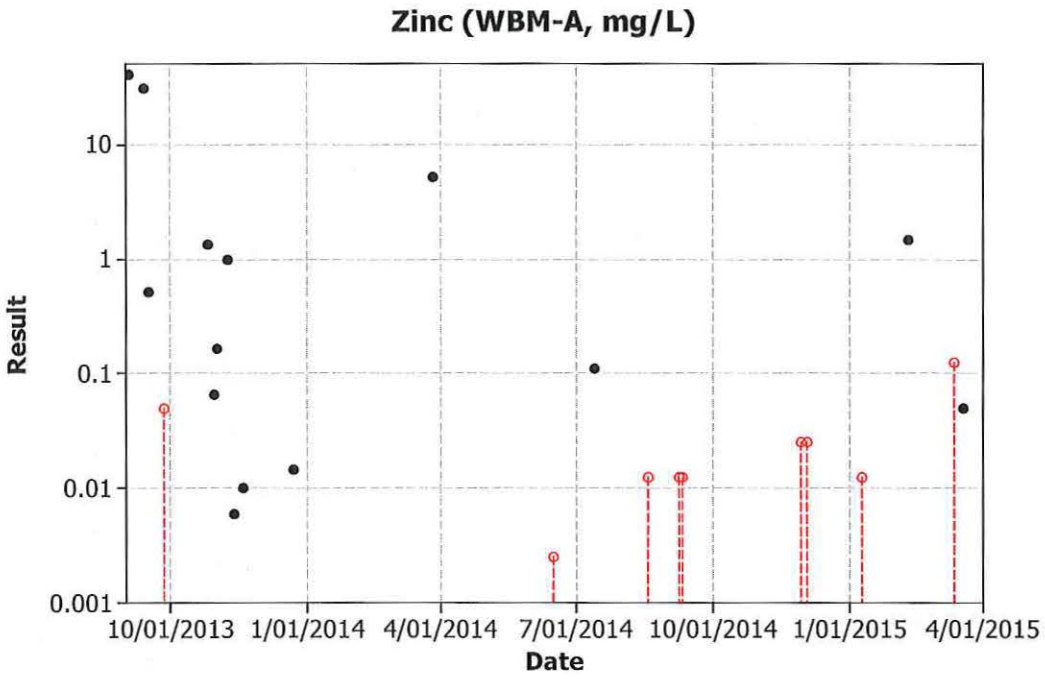
(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Silver)			
Total Number of Observations (#)	24	Number of Distinct Observations (#)	9
Number of Detects (#)	2	Number of Non-Detects (#)	22
Number of Distinct Detects (#)	2	Number of Distinct Non-Detects (#)	7
Minimum Detect (mg/L)	0.0393	Minimum Non-Detect (mg/L)	8.00E-04
Maximum Detect (mg/L)	0.133	Maximum Non-Detect (mg/L)	0.16
Variance Detects (mg/L)^2	0.00439	Percent Non-Detects (%)	91.67%
Mean Detects (mg/L)	0.0862	SD Detects (mg/L)	0.0663
Median Detects (mg/L)	0.0862	CV Detects	0.769
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects (log[mg/L])	-2.627	SD of Logged Detects (log[mg/L])	0.862

Figure E-44. Zinc (WBM-A, mg/L) General Statistics and Time Series

(Solid black circle: detected observations, open red circles with dashed line: non-detects plotted at modified MDL, general statistics computed with ProUCL v5.0.00.)



General Statistics (Zinc)			
Total Number of Observations (#)	23	Number of Distinct Observations (#)	18
Number of Detects (#)	14	Number of Non-Detects (#)	9
Number of Distinct Detects (#)	14	Number of Distinct Non-Detects (#)	5
Minimum Detect (mg/L)	0.00599	Minimum Non-Detect (mg/L)	0.0025
Maximum Detect (mg/L)	40.3	Maximum Non-Detect (mg/L)	0.125
Variance Detects $(mg/L)^2$	162	Percent Non-Detects (%)	39.13%
Mean Detects (mg/L)	5.743	SD Detects (mg/L)	12.73
Median Detects (mg/L)	0.342	CV Detects	2.217
Skewness Detects	2.358	Kurtosis Detects	4.518
Mean of Logged Detects (log[mg/L])	-1.068	SD of Logged Detects (log[mg/L])	2.81

E-6. References

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